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A Preliminary Study of the Industrial Hygiene Problems of the State of Montana

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A Report
Prepared by
DIVISION OF INDUSTRIAL HYGIENE

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HELENA, MONTANA

1941

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State of Montana

State Board of Health

W. F. COGSWELL, Secretary

HELENA, MONTANA

January 2, 1941

To His Excellency the Governor:

I have the honor to submit herewith a report of the survey of industrial hygiene carried out by the State Board of Health during 1940.

Respectfully submitted,

(Signed) W. F. COGSWELL, M. D.

Secretary.

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FOREWORD

The 1937 legislature of Montana passed Senate Joint Resolution number 6 requesting the Governor to appoint a commission to make a study of occupational diseases, particularly silicosis, and to make recommendations to the 1939 legislature. In response to this request, Governor Roy E. Ayers appointed on this commission James D. Graham, President of the Montana Federation of Labor, Denis McCarthy, a representative of the Trades and Labor Council of Silver Bow County, J. J. Carrigan, General Superintendent of Mines, A. C. M. Company, Carl J. Trauerman, President, Mining Association of Montana, and W. F. Cogswell, M. D., Secretary of the State Board of Health, as ex-officio member and chairman.

An appropriation of $5,000.00 was made to bear the expenses of this commission. On account of the smallness of the appropriation very little investigational work was possible but meetings were held in various parts of the State and at these meetings testimony was taken from representatives of labor and also of industry.

In its report to the legislature the commission recommended that an industrial hygiene division of the State Board of Health be created. This recommendation was carried out by the 1939 legislature. The State Board of Health appointed the members of the occupational disease commission and Dr. L. T. Sussex (who is chairman of the occupational disease committee of the Montana Medical Association) as an advisory committee to the State Board of Health in carrying out the law. No state appropriation was made for this work but we were able to secure an appropriation from the United States Public Health Service to start work. A doctor trained in industrial hygiene work was appointed as director and a trained industrial engineer and chemist also were appointed. An appropriation was secured from the United States Public Health Service to establish a laboratory which is located on the Capitol grounds. A preliminary report of the work of this division follows.

(signed) W. F. COGSWELL, M. D., Secretary

Montana State Board of Health.

INTRODUCTION

The United States Census for 1930 (1) showed Montana to have approximately 216,000 gainfully employed workers out of a total population of 537,606. Montana ranks fifth as an industrial State among the 11 Western States, being exceeded in number of industrial workers only by California, Washington, Oregon and Colorado (2). It is apparent that industrial hygiene, which means the protection of the health of workers, should be an important health activity of the State. A program of industrial hygiene must chiefly center itself about the smaller plants since 99.1 percent of the industrial plants employ less than 500 workers according to the 1930 census (4).

For the past several years, the people of Montana have recognized the need for improving the health of their gainfully employed. The twenty-fifth legislative assembly passed a resolution requesting the Governor to appoint a commission to investigate the occupational disease problems in the State. The commission was duly appointed, following which it held a series of hearings with representatives of labor and industry in industrial centers throughout the State to enable the commission to evaluate the occupational disease problems. At the conclusion of these investigations, the commission's report to the Governor included the following recommendations:

"Prevention and elimination of the causes of industrial disease should be carried forward vigorously, as prevention and elimination is preferable to compensation. Prevention of industrial disease must be made general to be successful. Therefore, we recommend that a law be enacted creating the Department of Industrial Hygiene of the State Board of Health, giving the department power to investigate industrial diseases and to make rules to enforce sanitary working conditions."

Acting upon these recommendations, the twenty-sixth legislative assembly passed an act "to create a Division of Industrial Hygiene within the State Board of Health of Montana, defining its powers and duties, requiring the reporting of occupational diseases and providing for the inspection of all places of employment where occupational disease may occur." Article 1, section 2 of this law states that the Division of Industrial Hygiene shall have the power "To make studies of industrial hygiene and occupational disease problems in the industries of Montana." In compliance with this provision, a study was undertaken to evaluate the industrial hygiene problems of the State, upon which a comprehensive program may be based.

This report presents the findings resulting from a preliminary survey in which 483 plants employing 27,541 workers were surveyed. Information was obtained in these plants as to the number of workers provided with welfare facilities, the number of exposures to potentially harmful materials and present attempts to control these exposures. This report also presents a statistical analysis of plants by number and size.

This study is a preliminary one and no attempt has been made to evaluate the degree of exposures or the effectiveness of control measures. These data, however, together with further studies to determine the actual hazards, will serve as a basis for the development of an industrial hygiene program in Montana.

PLAN AND SCOPE OF SURVEY

A study of the working conditions in the industries of Montana was conducted by making a preliminary survey of selected industries for the purpose of determining potentially harmful exposures to obtain information regarding industrial welfare facilities including sanitation, the number of persons exposed to harmful materials and the extent of the use of control measures. It should be emphasized that the exposure data in this report must not be interpreted as indicating the degree of exposure, but only the potentialities involved. Likewise, the presence of control measures merely indicates that these were available and does not infer that they were adequate.

Before undertaking this study, it was necessary to obtain a list of all industries in the State. This information was obtained from the Montana Unemployment Compensation Commission, making it possible to set up a card index file of all industrial plants in Montana. The plants in this card file were classified according to industry groups corresponding to the classifications of the Bureau of the Census (1). Cards representing industrial groups not included in this study were removed from the file as were the cards representing plants of less than five workers. The industry groups not included in this survey were agriculture, forestry and fishing, building, trade, professional and public service.

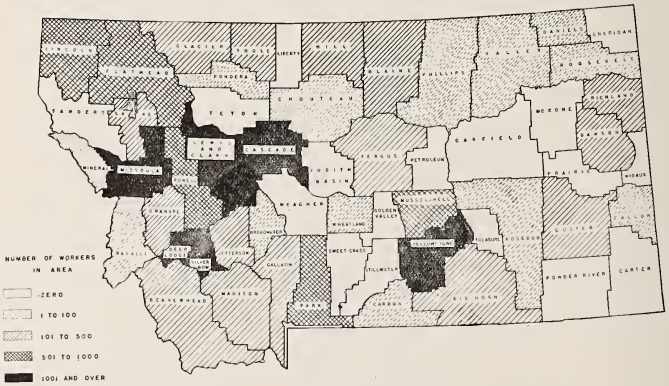
From the resulting file, a representative sample of the plants was selected for study. This was done by selecting at random all, every other, third, or fourth card, depending upon the number of plants in the industry group. Through this means of selection, an unbiased sample was obtained. A more complete discussion of this method of selecting a representative sample appears in Public Health Bulletin No. 259 (5). The sample selected consisted of 615 plants of which only 483 were surveyed. The remaining 132 plants were not surveyed because they were no longer in business, employed less than five workers, or were incorrectly classified. Figure 1 is a geographic presentation of the number of workers surveyed by counties.

To facilitate entry into the plants and to enlist the cooperation of industry, Dr. Cogswell, Secretary of the State Board of Health, prepared a letter of introduction which was sent to each plant approximately two weeks prior to the visit of the surveyor. This letter is presented in full below:

> Dear Sir:
>
> The 1939 Montana State Legislature passed an act creating a Division of Industrial Hygiene within the State Board of Health, and among other things, authorized the making of studies of Industrial Hygiene and occupational disease problems in the industries of Montana.
>
> In order to develop a program leading to a constructive health service in industry, the State Board of Health needs to obtain gen-

FIGURE 1

GEOGRAPHICAL DISTRIBUTION OF WORKERS IN MONTANA SURVEY



eral first-hand information concerning working conditions as they now exist in the State. The information so obtained will be used only for this purpose, and will be treated in such a confidential manner that the identity of any individual plant cannot be revealed.

In this connection, it may be pertinent to cite the fact that the law creating a Division of Industrial Hygiene also provides that all reports and records of the Division of Industrial Hygiene in the State of Montana pertaining to occupational disease shall not be admissable as evidence in any action at law or in any hearing under the Workmen's Compensation act of the state.

Within the next week or ten days, a properly identified representative of the Division of Industrial Hygiene of the Montana State Board of Health will call on you to obtain certain information essential for the constructive development of its program.

It will be very helpful if you could designate someone in your organization to give our representative the data needed, and to accompany him throughout the plant.

Your kind cooperation will be deeply appreciated.

Yours very truly,
(signed) W. F. COGSWELL,
Secretary

Two forms, which may be found in the appendix, were used in collecting the survey data. Form 3 dealt with information regarding safety, medical and sanitary provisions and only one form was used for each plant. Form 4 dealt with information regarding the number of workers according to occupation, the raw materials and by-products with which the workers came in contact and the control measures in use. One or more of these forms were used for each work room depending upon the number of separate occupations.

Upon completion of the survey, the forms were returned to the office, classified according to industry group and checked for consistancy and errors. Following this, all forms 4 were coded for material exposure according to the listing in the raw material and by-products column. Control measures were also checked when they affected a given material exposure. The data on the edited surveys were transposed to special tabulation forms and the results of the analysis of these data form the basis of all tables appearing in this report.

SUMMARY

(1) As the first step toward evaluating the industrial hygiene problems in Montana, 483 establishments employing 27,541 workers were studied. The industries in this survey were classified according to the United States Census for 1930 (1) as follows: extraction of mineral, manufacturing and mechanical transportation and personal service. The last two classifications were limited to a study of automobile garages and repair shops, laundries, dry cleaning and pressing plants, respectively.

(2) The 1930 United States Census (1) lists 216,471 gainfully employed workers in the State of Montana, 89,241 of whom were engaged in the industries studied. A 30.9 percent sample of these workers was studied in the present survey.

(3) Montana is the fifth most important industrial State of the eleven Western States, being exceeded in number of gainfully employed workers only by California, Washington, Oregon and Colorado (2).

(4) In the manufacturing and mechanical industries, 87.6 percent of the plants studied, employing 39.4 percent of the workers, were establishments of 100 or less population. In these industries 98.6 percent of the plants, representing 73.7 percent of the workers, were establishments of 500 or less population. Thus, nearly three-fourths of the workers studied were employed in small plants.

(5) In general, Montana industries are not economically able to render adequate industrial hygiene services, since they are predominately small establishments.

(6) Certain health services available to the workers in Montana industries were found to be inadequate.

(7) More complete health facilities were provided to the workers in plants employing more than 100 than in plants employing 100 or less.

(8) Comparison of industrial health facilities with the 15 State survey shows that the industries in Montana are particularly deficient in such provisions as physician, nurse, first-aid room, sick benefit organization and sickness records. A higher percentage of Montana workers are, however, provided with full time safety directors and trained first-aid workers.

(9) Of the 27,541 workers surveyed, there were 79,688 exposures to the 47 toxic materials considered. The principal exposures to potentially

---

[1] This is a report by the United States Public Health Service of the analysis of industrial hygiene surveys conducted in 15 States, representing all sections of the United States and covering 16,803 plants employing 1,487,224 workers. This report states that, "It is felt that the sample is sufficiently adequate and representative of industrial conditions in this country to warrant considering the data applicable to all industrial establishments of the type studied in the United States."

The surveys in the 15 States which are compiled and analyzed in this report, were conducted by the States through cooperation with the United States Public Health Service during the period 1936 to 1939. The data collected in these surveys were standardized as much as possible and, for this reason, this report was used as a frequent reference.

harmful materials were to silica dust (7,670), high humidity (7,550), other gases (7,401), silicate dust (7,376), extreme temperature change (7,342), other metals (7,330), carbon monoxide (7,035), petroleum products (3,849), oils, fats and waxes (3,445), mineral acids (3,290), and lead (3,194).

(10) Based upon the survey sample which was felt to be representative, the number of workers which may be expected to be exposed to certain important harmful materials are:

24,809 to silica dust.
24,452 to high humidity.
24,005 to other gases.
23,916 to silicate dust.
22,756 to carbon monoxide.
10,352 to lead.

(11) Of the 79,688 workers exposed to potentially harmful materials, 26.1 percent (20,778) had no control measures provided. The most common measures used for controlling exposures were general ventilation (59.4 percent) and wet methods (22.9 percent).

DISCUSSIONS AND CONCLUSIONS

From the selected sample of the industries surveyed, it can be expected that there are approximately 258,000 potentially harmful exposures among workers in Montana. Although the degree of exposure to harmful materials was not determined, the data available are of sufficient magnitude to present a problem of definite public health significance.

The survey revealed that a large percentage of the exposed workers had no control provided, and that many of the existing control measures were probably inadequate. Maintenance of existing control measures and need for the installation of new ones, necessarily depends upon such factors as toxicity of the material to which workers are exposed, the state in which it exists, how it is used, and the amount present in the working environment. Scientific correction of such problems can be brought about only through engineering and chemical studies which require a well equipped laboratory, elaborate field equipment, and the services of trained industrial hygiene personnel. Since approximately three-fourths of the industrial workers in Montana are in plants employing less than 500, and it is not practical for plants of this size to provide adequate industrial hygiene service (3) to their employees, it is inevitable that such services be provided for them. From the information presented in this report, it should be apparent that the improvement and protection of the health of industrial workers be an integral and indispensible part of a public health program. There is sufficient knowledge available concerning the effects and control of hazardous environmental conditions on the health of industrial workers, which if applied, will effectively decrease occupational illness. An earnest effort, therefore, should be made to close this gap between the knowledge of how to control and prevent industrial illness and the practical application of this knowledge to the conditions revealed in this report.

This study reveals that the industrial workers in this State were not adequately provided with health services such as full time physicians and nurses, first-aid rooms and sickness records. The lack of these facilities was more marked in the small plants because, as stated above, it is impractical for them to provide such services. Thus, it seems apparent that concerted effort on the part of industry, governmental agencies and others, is needed to effect an adequate program of industrial hygiene. Through cooperation of these agencies, health programs in industry can be formulated, which should substantially reduce the amount of lost time from industry due to illness.

The need for improvement and protection of the health of workers through an industrial hygiene program is presented in a report of the Council of Industrial Health of the American Medical Association (6) in which three major activities are outlined. These are:

(1) Medical and surgical care to accomplish prompt restoration to health and earning capacity following industrial accident or disease.

(2) Prevention of disease or injury in industry by the establishment of proper control over industrial environment.

(3) Education of employees about healthful living both in and out of the industrial environment.

It is believed that the Division of Industrial Hygiene may follow the program outlined above, except for item number one, and through a generalized public health program all services of the State Board of Health may be extended to the homes and workplaces of the industrially employed of Montana.

RECOMMENDATIONS

(1) That detailed field and laboratory studies be undertaken to bring about adequate control measures for dermatitis producing materials, dusts, fumes, vapors, mists and gases.

(2) That the Montana State Board of Health through its Division of Industrial Hygiene offer advisory and consultive medical, engineering, and laboratory services to industry.

(3) That the Division of Industrial Hygiene should, in compliance with existing legislation, remain a neutral fact-finding agency whose records and findings are confidential between a given industry and the division.

(4) That reporting of occupational diseases by physicians be inaugurated in compliance with existing statutes, and that a system of reporting absenteeism by industry, be instigated. With this combined information, the Division of Industrial Hygiene will be in a position to assist both industry and labor by finding causes for lost time in industry and taking steps to eliminate them. Through analysis of such records, many points of origin of occupational diseases may be located and control measures affected before additional cases occur.

(5) That existing industrial health provisions be increased in order to reach a larger percentage of industrial workers. One such provision that is inadequate in Montana is that of industrial nurses. Many of the larger plants could profitably employ full time registered or Public Health Nurses with some special training in industrial hygiene. The smaller plants should have a nursing service plan on a part time basis which might be developed in cooperation with other small industries or with existing health agencies through an extended nursing program.

(6) That this division establish itself as a service division of the State Board of Health to industry and interested agencies.

(7) That this division cooperate closely with the Montana Industrial Accident Board, the Department of Agriculture, Labor, and Industry, and other Federal, State, and local agencies in preventing occupational illness.

(8) That a general educational program be undertaken by the division offering speakers, literature, motion pictures, and demonstrations to interested groups on the subject of protection of health in industry.

(9) That a complete industrial hygiene library be maintained by this division for use by all interested persons, groups and organizations.

(10) That through cooperation with other divisions of the Montana State Board of Health, the services of that agency be made more readily available to the industrially employed in their homes and work places.

(11) That impartial health appraisals of all workers be instigated with provisions for rehabilitation within industry.

(12) That this division provide consultant services to private physicians, medical supervisors and others, regarding occupational diseases.

(13) That the State of Montana should identify itself as one which endorses a program of health protection of its workers and should appropriate funds for the furthering of industrial hygiene by supplementing Federal funds on which this division has been operating to date.

ACKNOWLEDGMENTS

The reception of the industrial hygiene program among the industrial officials of the State and their cooperation with this study was particularly gratifying. Thanks are extended to the United State Public Health Service for making funds available for conduction of this program. The assistance extended this division by J. J. Bloomfield and Richard T. Page of the Industrial Hygiene Division of the United States Public Health Service in planning and conducting this survey is appreciated. The Montana Unemployment Compensation Commission was particularly cooperative in furnishing a list of all industries in the State. Recognition is due the Industrial Hygiene Advisory Committee for assisting in planning and conducting this survey. Thanks is also due Miss Dorothy Goodman for her excellent work in tabulating all data collected.

RESULTS OF SURVEY

TYPE OF INDUSTRIES

Table 1 lists the types of industries studied together with the number of workers and number of plants in each industry. This classification of industries conforms to that used in the United States Census (1). The number of workers in each industry is listed by male, female and total. Of the total 483 plants surveyed involving 27,541 workers, 16,362 workers in 280 plants were in the manufacturing and mechanical industries. This industry group was the largest studied and was made up of 11 classifications some of which were further subdivided into minor groups in order to disclose in as great detail as possible the types of industries forming the basis of this study.

The second largest industry group studied was extraction of minerals consisting of 98 establishments employing 9,329 workers. In the transportation group, 67 automobile repair shops and garages were surveyed involving 944 workers. The personal service group was made up of 35 plants employing 774 workers in laundries, cleaning, dyeing and pressing shops.

Other studies have shown that by far the most important industry groups to consider from the viewpoint of exposure to occupational health hazards are extraction of minerals and manufacturing and mechanical industries. Some of the service groups were included in this study, however, in order to yield a more representative picture of the entire industrial health problem of the State.

It will be noted at the end of this table that there are three plants employing 132 workers in not specified industries. These represent plants surveyed which do not fall under the specific classifications in this table.

Table 2 presents a comparison of workers surveyed with the number of workers shown to be employed in these industries by the 1930 United States Census of Montana (1). The table also presents the percentage of workers surveyed in each group. According to the 1930 United States Census (1), there were 216,471 gainfully employed persons in Montana. As stated in an earlier section of this report, the agriculture, forestry and fishing, trade, professional, and public service industries were eliminated from this study. These industries comprise a total of 127,230 workers which when deducted from the census total of 216,471 leaves 89,241 workers and is the census total for the industry groups studied.

Table 2 also shows that the survey sample comprised of 30.9 percent of the census population for all industries surveyed (89,241). In extraction of minerals 52.8 percent of the workers were surveyed and in the manufacturing and mechanical industries 41.9 percent. In transportation and communication, only 8.3 percent of the workers were surveyed. This is accounted for, however, by the fact that the census figure includes all phases of transportation and communication, whereas this study was limited to the automobile repair shops, garages, and automobile service groups. In this group 25.1 percent of the workers in the State were surveyed.

TABLE 1—NUMBER OF PLANTS AND WORKERS SURVEYED BY INDUSTRY

Industry or Service Group	Number of Plants	Number of Workers		
		Total	Male	Female
ALL INDUSTRIES	483	27,541	26,147	1,394
EXTRACTION OF MINERALS	98	9,329	9,251	78
Coal Mines	23	1,009	998	11
Metal Mines	61	7,897	7,843	54
Quarries	7	103	101	2
Oil and Gas Wells	7	320	309	11
MANUFACTURING & MECHANICAL IND.	280	16,362	15,615	747
Chemical and Allied Industries	14	805	792	13
Petroleum Refineries	11	634	621	13
Other Chemical	3	171	171	0
Clay, Glass and Stone Industries	21	294	289	5
Brick and Tile	7	106	105	1
Lime, Cement and Artificial Stone	4	143	142	1
Other Clay, Glass and Stone	10	45	42	3
Clothing Industries	4	44	19	25
Food and Allied Industries	93	3,823	3,323	500
Bakeries	24	421	297	124
Dairy Products	23	316	227	89
Flour and Grain Mills	9	276	246	30
Slaughter and Packing	11	477	426	51
Sugar Refineries	5	1,849	1,727	122
Liquor and Beverage	15	251	237	14
Other Food Factories	6	233	163	70
Iron and Steel Industries	65	3,896	3,861	35
Car and Railroad Shops	20	2,770	2,750	20
Other Iron and Steel	45	1,126	1,111	15
Metal Industries Except Iron and Steel	10	3,876	3,843	33
Leather Industries	6	32	32	0
Lumber Industries	23	2,507	2,484	23
Saw and Planing Mills	12	1,726	1,714	12
Other Woodworking Factories	11	781	770	11
Paper, Printing and Allied Industries	24	824	720	104
Textile Industries	7	23	20	3
Miscellaneous Manufacturing Industries	13	238	232	6
TRANSPORTATION & COMMUNICATION	67	944	884	60
Auto Repair Shops, Garages & Auto Service	67	944	884	60
PERSONAL SERVICE	35	774	265	509
Laundries	20	649	198	451
Cleaning, Dyeing and Pressing	15	125	67	58
NOT SPECIFIED INDUSTRIES	3	132	132	0

The lowest percentage of workers surveyed (4.8 percent) occurred in the domestic and public service group. This is accountable by the fact that only laundries, cleaning, dyeing and pressing shops were surveyed in this industry classification. Of the workers in this industry, 58.2 percent were surveyed. To summarize, this table indicates the adequacy and representativeness of the survey sample when the analysis is limited to those industry groups from which the study sample was taken.

TABLE 2—NUMBER AND PERCENT OF WORKERS SURVEYED, BY INDUSTRY, COMPARED WITH THE 1930 UNITED STATES CENSUS OF MONTANA

Industry or Service Group	Total Workers 1930 Census[1]	Workers Surveyed	
		Number	Percent
ALL INDUSTRIES SURVEYED	89,241	27,541	30.9
EXTRACTION OF MINERALS	17,655	9,329	52.8
Coal Mines	2,428	1,009	41.6
Other Mines and Quarries	14,139	8,000	56.6
Oil and Gas Wells	1,088	320	29.4
MANUFACTURING AND MECHANICAL INDUSTRIES	39,012[2] [3]	16,362	41.9
Building Industry	6,175	NONE	.....
Chemical and Allied Industries	837	805	96.2
Cigar and Tobacco Factories	60	NONE	.....
Clay, Glass and Stone Industries	324	294	88.0
Clothing Industries	491	44	9.0
Food and Allied Industries	2,622	3,823[4]	145.8[4]
Iron and Steel Industries	18,075[2]	3,896	21.6
Metal Industries Except Iron and Steel	2,045	3,876[5]	189.5[5]
Leather Industries	91	32	35.2
Lumber and Furniture Industries	2,579	2,507	97.2
Paper, Printing and Allied Industries	1,168	824	70.4
Independent Hand Trades	1,312	NONE	.....
Textile Industries	63	23	36.5
Miscellaneous Manufacturing Industries	2,160	238	11.0
TRANSPORTATION & COMMUNICATION	11,349[2] [3]	944	8.3
Auto Repair Shops, Garages & Auto Service	3,755[3]	944	25.1
Other Transportation and Communication	8,594	NONE	.....
DOMESTIC AND PERSONAL SERVICE	16,202	774	4.8
Laundries, Cleaning and Pressing Shops	1,330	774	58.2
Other Domestic and Personal Service	14,872	NONE	.....
NOT SPECIFIED INDUSTRIES	5,023	132	2.6

[1] U. S. Census (1930).

[2] 13,156 Steam and Street Railroad workers were taken from the Transportation and Communication group of the Census and added to the Iron and Steel group under Manufacturing and Mechanical Industries.

[3] 1,126 Automobile factory and repair shop workers were taken from the Manufacturing and Mechanical Industries group of the Census and added to the Auto Repair Shop, Garages, and Auto Service group under Transportation and Communication.

[4] Because of the seasonal nature of certain of the Food and Allied Industries, the Census figures are lower than the figures in the surveyed column as these industries (Canning and Sugar) were surveyed during their peak seasons. Workers in these industries at the time the Census was taken might well have been employed in other occupations which were given as their regular employment.

[5] Milling and refining of non-ferrous ores was included by the United States Census under "Other Extraction of Minerals." In analyzing the survey data, mills and smelters operated separately from mines were included under "Metals, Other Than Iron and Steel" in the Manufacturing and Mechanical Industries.

SIZE OF PLANTS

In order that some conception of the size of the establishments surveyed may be obtained, there is offered in tables 3 and 4 a distribution of the plants and workers in the manufacturing and mechanical industries by size. Table 3 shows a comparison of the size distribution of plants by number and percent of plants, while table 4 shows the comparison by number and percent of workers. The survey data are compared with the information available from the census for the United States, 15 States, and Montana, and the survey sample of the 15 States. Before an examination of the table is attempted attention is called to two facts: First, the data in these two tables are limited to classifications under manufacturing and mechanical industries since census data for other industrial classifications are not available, and second, the census distributions are based on wage earners only, while the distributions of the survey samples are based on both salaried employees and wage earners. The census data on plant size distribution were taken from the Manufacturer's Census for 1929 (4) because it was felt that present day employment figures compared more closely with this census than with previous ones. It will be observed from table 3 that, in general, the survey sample agrees closely with the Montana Census. In this survey, the percentage of plants (44.6 percent) employing 6 to 20 workers is higher than that for the United States as a whole (25.6 percent) and for the 15 States survey (36.1 percent). This causes the percentage in each group of progressively larger plants to be somewhat smaller than that for the 15 State survey, although the general pattern of the size distribution is very similar.

Although our survey sample showed 16.4 percent of the plants studied to be comprised of those employing 5 workers and under, this is probably low since this study was primarily limited to plants employing 5 or more workers, and only in exceptional cases were smaller plants included. Such small plants were included only when it was felt necessary to do so in order to get a fair representative sample of any particular industry group in the State. Conversely, the Montana Census which showed 59.3 percent of the plants in the State to have 5 or less workers is probably high since the census does not include salaried employees. Thus, were the census to include salaried workers as was done in this study, the percentage of plants employing 5 or less workers would have been smaller and the percentage employing 6 to 20 workers, larger.

The above discussion relating to number of plants also pertains to the number of workers in plants employing less than 5 workers and 6 to 20 workers as shown in table 4.

According to tables 3 and 4, the group of plants employing 5 or less workers comprises 16.4 percent of all the plants and 1.1 percent of all the workers surveyed as compared to 8.7 percent and 0.4 percent respectively for the 15 States. An analysis of these tables also shows that establishments employing 100 workers or less make up 87.6 percent

TABLE 3—COMPARISON OF THE SIZE DISTRIBUTION OF PLANTS BY NUMBER AND PERCENT OF PLANTS IN THE MANUFACTURING INDUSTRIES OF MONTANA WITH THE UNITED STATES AND THE 15 STATES SURVEY

Size of Plant (Number of Workers Employed)	Percent of Plants					Number of Plants				
	United States (Census)	15 States (Census)	15 States Survey Sample[1]	Montana (Census)	Montana Survey Sample	United States (Census)[2]	15 States (Census)[2]	15 States Survey Sample[1]	Montana (Census)[2]	Montana Survey Sample
All Plants	100.0	100.0	100.0	100.0	100.0	203,533	57,162	14,547	567	280
5 workers and under	47.1	47.1	8.7	59.3	16.4	95,767	26,913	1,266	336	46
6 to 20 workers	26.3	25.6	36.1	24.3	44.7	53,524	14,615	5,248	138	125
21 to 50 workers	12.3	12.1	22.2	7.6	17.2	25,022	6,945	3,224	43	48
51 to 100 workers	6.1	6.3	13.7	3.5	9.3	12,467	3,613	1,992	20	26
101 to 250 workers	5.0	5.4	11.7	2.6	7.1	10,195	3,085	1,700	15	20
251 to 500 workers	1.9	2.0	4.5	1.8	3.9	3,840	1,130	656	10	11
501 to 1,000 workers	0.8	1.0	2.0	0.9	0.7	1,722	550	298	5	2
1,001 to 2,500 workers	0.4	0.4	0.9		0.7	790	224	131	[3]	2
2,501 or more workers	0.1	0.1	0.2	.....	.....	206	77	32	.....	.....

[1] Pub. Health Bulletin No. 259.

[2] U. S. Census, 1929 Manufacturing Series (1930). Census data are based on wage earners only while the survey data are based on both salaried employees and wage earners.

[3] Combined to correspond with table 4.

TABLE 4—COMPARISON OF THE SIZE DISTRIBUTION OF PLANTS BY NUMBER AND PERCENT OF WORKERS IN THE MANUFACTURING INDUSTRIES OF MONTANA WITH THE UNITED STATES AND THE 15 STATES SURVEY

Size of Plant (Number of Workers Employed)	Percent of Workers					Number of Workers				
	United States (Census)	15 States (Census)	15 States Survey Sample[1]	Montana (Census)	Montana Survey Sample	United States (Census)[2]	15 States (Census)[2]	15 States Survey Sample[1]	Montana (Census)[2]	Montana Survey Sample
All Plants	100.0	100.0	100.0	100.0	100.0	8,838,743	2,696,135	1,373,909	14,869	16,362
5 workers and under	3.2	2.9	0.4	5.8	1.1	279,734	79,261	5,533	867	186
6 to 20 workers	6.7	6.0	4.4	9.5	8.2	595,708	161,629	61,089	1,413	1,332
21 to 50 workers	9.2	8.5	7.8	8.9	9.4	814,465	227,897	106,479	1,320	1,536
51 to 100 workers	10.1	9.6	10.3	9.5	10.7	891,671	258,928	141,614	1,412	1,759
101 to 250 workers	18.0	17.8	19.4	16.2	20.4	1,589,040	478,685	266,548	2,414	3,334
251 to 500 workers	15.0	14.7	16.6	22.4	23.9	1,331,145	396,633	228,393	3,329	3,908
501 to 1,000 workers	13.3	14.0	14.5	{	6.6	1,176,991	377,789	199,391	{	1,084
1,001 to 2,500 workers	13.0	12.1	13.7	{27.7	19.7	1,144,735	326,738	188,202	[3]{4,114	3,223
2,501 or more workers	11.5	14.4	12.9	.....	.....	1,015,254	388,575	176,660	.....	.....

[1] Pub. Health Bulletin No. 259.

[2] U. S. Census, 1929 Manufacturing series (1930). Census data are based on wage earners only while the survey data are based on both salaried employees and wage earners.

[3] Combined to avoid disclosing number of wage earners reported by an individual establishment.

of the establishments employing 29.3 percent of the workers in this survey and 80.7 percent employing 22.9 percent of the workers in the 15 States survey. Comparable figures for the United States and Montana according to the United States Census are presented.

A further comparison of the percentage distribution of plants according to size and number of workers for the manufacturing and mechanical industries is presented graphically in figures 2 and 3 respectively.

If a dividing line between small and large plants be chosen at 500 workers, it is found in this study that 98.6 percent of all the plants in Montana fall within the catagory of small plants. In the manufacturing and mechanical industries, this group of small plants (500 or less) employs over one-half of all the workers, namely: 62.2 percent of all the workers in the United States, 58.9 percent of the 15 State survey sample, and 73.7 percent of this survey.

From the foregoing comparisons in tables 3 and 4 and figures 2 and 3, it will be noted that the data obtained for Montana in this study compare favorably with census data for the United States and Montana and the 15 States survey.

The National Industrial Conference Board and the American College of Surgeons (5) have shown in their studies that it is the small plants of the size employing 500 workers or less in which it is uneconomical to carry on adequate industrial hygiene services and that, as a rule, such services are existent only in the larger plants. Since the small plant does predominate in number of workers, it becomes the duty of official health agencies to provide an adequate preventive program of industrial health for these workers.

FIGURE 2

PERCENTAGE DISTRIBUTION OF PLANTS IN THE MANUFACTURING AND MECHANICAL INDUSTRIES ACCORDING TO SIZE

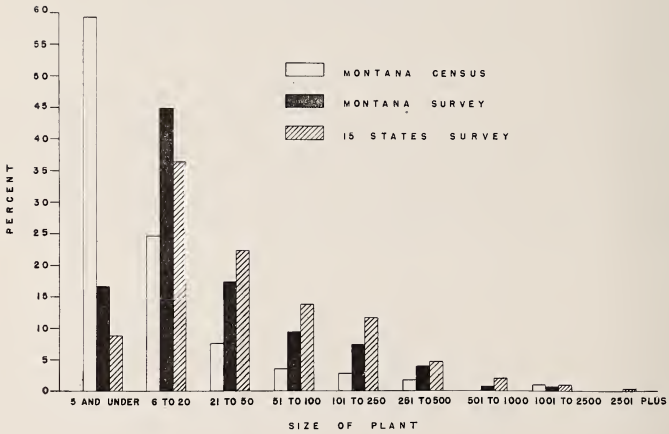
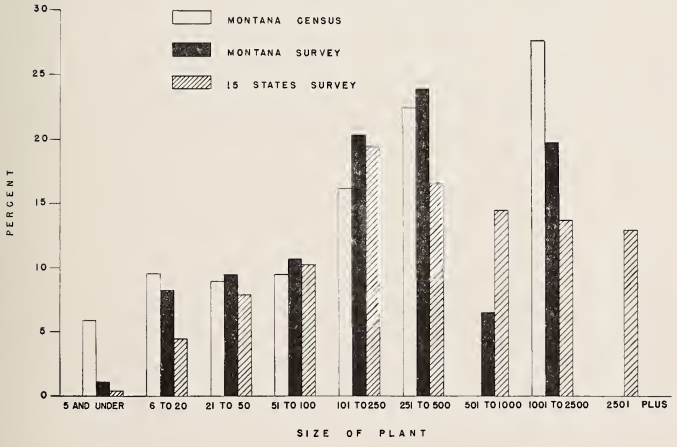


FIGURE 3

PERCENTAGE DISTRIBUTION OF WORKERS IN THE MANUFACTURING AND MECHANICAL INDUSTRIES ACCORDING TO SIZE OF PLANT



INDUSTRIAL HEALTH SERVICE PROVISIONS

Because industrial health services have been known to exert favorable and far-reaching influence on the health of the industrial worker, it was deemed desirable to obtain some information on the extent to which they were provided in the plants under consideration. In this study, no attempt was made to determine the completeness of the provision or service, but merely its presence. These data were collected under the major headings safety provisions, medical provisions, disability statistics and sanitary provisions, and are considered separately under these headings.

SAFETY PROVISIONS

Table 5 shows the percentage of workers by industry groups to whom the indicated safety provision is available. The services of a full time safety director were available to 34.7 percent of the workers studied, 21.7 percent had the services of a safety director who donated some part of his time to this work, and 43.3 percent of the workers had services of shop committees which were engaged in promoting safety. Plants receiving some safety service from private insurance companies such as bulletins, posters and safety inspections, employed 23.4 percent of the workers. A high percentage of the workers (85.5 percent) was covered by one of the three plans of the Montana Industrial Accident Board and received the benefits available from such coverage, and/or some other safety provisions such as membership in the National Safety Council or the Air Hygiene Foundation.

TABLE 5—INDUSTRIAL HEALTH SERVICE — SAFETY PROVISIONS

Industry or Service Group	Number of Plants	Number of Workers	Percent of Workers to Whom Service is Available				
			Safety Director		Shop Committees	Insurance Services	Other Services
			Full Time	Part Time			
All Industries	483	27,541	34.7	21.7	43.3	23.4	85.5
EXTRACTION OF MINERALS	98	9,329	63.0	9.2	10.7	2.8	98.2
Coal Mines	23	1,009	.....	38.5	56.7	.....	98.2
Metal Mines	61	7,897	74.4	2.5	2.2	1.6	78.5
Quarries	7	103	.....	.....	.....	.....	100.0
Oil and Gas Wells	7	320	.....	72.2	66.6	31.9	94.1
MANUFACTURING AND MECHANICAL INDUSTRIES	280	16,362	22.5	30.5	66.6	34.4	79.9
Chemical and Allied Industries	14	805	.....	63.2	38.8	45.1	79.3
Clay, Glass and Stone Industries	21	294	.....	21.1	15.2	9.9	74.1
Clothing Industries	4	44	.....	.....	.....	45.5	47.7
Food and Allied Industries	93	3,823	.....	7.5	55.3	52.5	89.3
Iron and Steel Industries	65	3,896	.....	74.7	84.6	60.6	42.2
Metal Industries Except Iron and Steel	10	3,876	94.9	3.0	95.9	.....	100.0
Leather Industries	6	32	.....	.....	.....	12.5	37.5
Lumber Industries	23	2,507	.....	34.1	53.9	21.6	99.6
Paper, Printing and Allied Industries	24	824	.....	21.0	.....	36.2	62.6
Textile Industries	7	23	.....	.....	.....	.....	56.5
Miscellaneous Manufacturing Industries	13	238	.....	34.0	34.0	1.3	94.5
TRANSPORTATION AND COMMUNICATION	67	944	.....	6.7	3.6	38.2	66.3
PERSONAL SERVICE	35	774	.....	7.2	.....	25.2	70.5
NOT SPECIFIED INDUSTRIES	3	132	.....	.....	.....	.....	100.0

MEDICAL PROVISIONS

Table 6 shows the percentage of workers by industry groups to whom the indicated medical provision is available. It shows that hospital facilities were available to 57.4 percent of the workers studied. The services of a company-owned hospital located at or convenient to the plant were provided for 4.2 percent of the workers, and 53.2 percent were employed by companies having a hospital contract. This 53.2 percent group included 2.0 percent who were furnished with facilities of an insurance company hospital.

First-aid rooms were available to 21.4 percent of the workers, whereas 94.3 percent had available first-aid kits and 66.5 percent had available the services of a trained first-aid worker. The relatively high percentage of workers having first-aid facilities available is affected to a large extent by the extraction of minerals and metal except iron and steel industries which made these facilities available to practically 100 percent of their workers. This table indicates that relatively few workers had the services of physicians and nurses. Only 3.1 percent of the workers had the services of a full time physician and 6.2 percent a part time physician. A large number of workers (65.6 percent) depended upon on-call physicians, whereas 25.1 percent had no arrangements for care by physicians. This indicates that little is being done in the way of a generalized medical program in the industries of Montana, and that in the majority of cases a physician is called only to treat specific injuries. A full time registered nurse was provided for 14.6 percent of the workers and 5.0 percent had the services of a part time nurse with the remaining 80.4 percent having no available nursing service. This indicates a definite need in the industry of Montana for increased nursing service.

Of all workers studied 18.8 percent were given pre-employment physical examinations and 10.9 percent were given periodical physical examinations.

TABLE 6—INDUSTRIAL HEALTH SERVICE—MEDICAL PROVISIONS

Industry or Service Group	Number of Plants	Number of Workers	Percent of Workers to Whom Service Is Available												
			Hospital			First Aid Room	First Aid Kit	First Aid Worker	Physician			Nurse		Physical Examinations	
			Company	Insurance	Contract				Full Time	Part Time	On Call	Full Time	Part Time	Pre-Employment	Periodical
All Industries	483	27,541	4.2	2.0	51.2	21.4	94.3	66.5	3.1	6.2	65.6	14.6	5.0	18.8	10.9
EXTRACTION OF MINERALS	98	9,329	.....	2.0	75.8	3.4	98.2	90.6	.....	0.7	84.5	.....	1.6	2.5	.....
Coal Mines	23	1,009	.....	2.5	52.9	23.5	97.5	83.7	.....	6.6	82.0	.....	.....	.....	.....
Metal Mines	61	7,897	.....	2.1	81.1	.....	98.4	93.4	.....	.....	87.6	.....	1.9	.....	.....
Quarries	7	103	.....	.....	.....	.....	76.7	.....	.....	.....	8.7	.....	.....	.....	.....
Oil and Gas Wells	7	320	.....	.....	40.6	25.9	100.0	72.2	.....	.....	40.6	.....	.....	72.2	.....
MFG. & MECHANICAL IND.	280	16,362	7.1	2.1	42.0	34.6	92.5	58.7	5.2	9.9	60.8	24.2	7.5	30.2	18.3
Chemical and Allied Industries	14	805	.....	.....	21.2	15.0	100.0	66.0	.....	15.0	32.8	.....	.....	42.0	29.6
Clay, Glass and Stone Industries	21	294	.....	.....	36.0	15.3	75.2	17.0	.....	.....	54.4	.....	15.3	30.3	.....
Clothing Industries	4	44	.....	.....	.....	.....	93.2	.....	.....	.....	.....	.....	.....	.....	.....
Food and Allied Industries	93	3,823	.....	.....	12.0	23.4	77.6	25.8	.....	9.1	26.3	.....	.....	42.4	40.0
Iron and Steel Industries	65	3,896	29.9	5.6	38.6	15.3	98.6	51.9	12.3	23.2	72.5	15.8	21.1	44.5	24.9
Metal Industries Except Iron and Steel	10	3,876	.....	.....	65.5	95.9	100.0	97.4	.....	6.5	92.0	83.2	6.3	6.5	6.5
Leather Industries	6	32	.....	.....	.....	.....	28.1	.....	.....	.....	.....	.....	.....	.....	.....
Lumber Industries	23	2,507	.....	5.2	76.4	5.1	98.2	83.8	14.9	.....	76.6	1.8	3.2	35.9	.....
Paper, Printing and Allied Industries	24	824	.....	.....	7.5	.....	87.7	0.6	.....	.....	7.5	7.5	.....	.....	.....
Textile Industries	7	23	.....	.....	.....	.....	17.4	.....	.....	.....	.....	.....	17.4	.....	.....
Miscellaneous Mfg. Industries	13	238	.....	.....	45.4	34.0	78.2	58.0	.....	.....	62.6	16.8	17.2	.....	.....
TRANSPORTATION AND COMMUNICATION	67	944	.....	1.7	4.6	.....	87.6	10.1	.....	.....	4.6	3.6	.....	.....	.....
PERSONAL SERVICE	35	774	.....	.....	.....	.....	91.1	3.5	.....	.....	5.9	0.6	.....	.....	.....
NOT SPECIFIED INDUSTRIES	3	132	.....	.....	100.0	.....	100.0	100.0	.....	.....	100.0	.....	.....	.....	.....

DISABILITY STATISTICS

The value of keeping accident and sickness records is well recognized as an important function in a constructive industrial hygiene program. Such records serve to indicate the extent of an existing health problem and often become the means of initiating steps designed for the correction of undesirable conditions. A typical example of such a case is the study of pneumonia in the steel industry as undertaken by the United States Public Health Service (7). A study of sickness records revealed the incidence of pneumonia to be high in a given area and further revealed the rate to be particularly high in the iron and steel industry with a majority of cases occurring in the blast furnace departments.

Table 7 shows that only 13.2 percent of the workers had the advantages of sickness records while 92.8 percent are provided with accident records. Sick benefit organizations, which are maintained to provide payments to workers during periods of disability from sickness or non-industrial accidents, were provided for 17.6 percent of the workers in this study.

TABLE 7—INDUSTRIAL HEALTH SERVICE PROVISIONS—DISABILITY STATISTICS

Industry or Service Group	Number of Plants	Number of Workers	Percent of Workers to Whom Service is Available		
			Sick Benefit Organization	Sickness Records	Accident Records
All Industries	483	27,541	17.6	13.2	92.8
EXTRACTION OF MINERALS	98	9,329	10.1	1.5	98.9
Coal Mines	23	1,009	40.9	.....	98.9
Metal Mines	61	7,897	3.6	0.7	99.0
Quarries	7	103	.....	.....	100.0
Oil and Gas Wells	7	320	78.1	25.9	97.8
MANUFACTURING AND MECHANICAL INDUSTRIES	280	16,362	23.2	21.3	93.1
Chemical and Allied Industries	14	805	65.5	55.2	98.9
Clay, Glass and Stone Industries	21	294	.....	40.6	81.6
Clothing Industries	4	44	.....	.....	79.5
Food and Allied Industries	93	3,823	30.5	16.4	87.3
Iron and Steel Industries	65	3,896	39.9	15.7	9..8
Metal Industries Except Iron and Steel	10	3,876	.....	40.9	100.0
Leather Industries	6	32	.....	.....	25.0
Lumber Industries	23	2 507	21.0	3.2	97.6
Paper, Printing and Allied Industries	24	824	.....	0.8	55.8
Textile Industries	7	23	.....	.....	49.1
Miscellaneous Manufacturing Industries	13	238	.....	.....	88.7
TRANSPORTATION & COMMUNICATION	67	944	6.0	.....	56.9
PERSONAL SERVICE	35	774	4.6	.....	58.6
NOT SPECIFIED INDUSTRIES	3	132	.....	.....	100.0

SANITARY PROVISIONS

Adequate sanitary facilities are important for the protection of the health of workers and without them it is impossible to maintain the health of this group.

Table 8 presents data collected on the water supply, drinking and washing facilities and waste disposal by plants in the various industry groups. Although many problems are presented through a study of this table, the most striking point is the high percentage (30.6 percent) of workers using common drinking cups. From the public health standpoint, this fact is very important because of the possibility of spread of communicable diseases.

This table also indicates the danger of spread of disease to others through inadequate waste disposal. Of all workers studied, 48.1 percent were provided with private disposal for human waste and 34.8 percent worked in plants which disposed of their industrial wastes into streams. These methods of disposal may constitute serious health problems and warrant further study, since streams into which such water is disposed might be used as a source of drinking water by individuals or entire communities.

The aim of this study has been to determine the sanitary provisions afforded Montana workers in order to indicate what future studies may be necessary. No attempt has been made to determine the adequacy of present sanitary provisions.

TABLE 8—INDUSTRIAL HEALTH SERVICE—SANITARY PROVISIONS

Industry or Service Group	Number of Plants	Number of Workers	Percent of Workers to Whom Service Is Available																		
			Water Supply				Drinking Facilities			Washing Facilities					Waste Disposal						
				Private											Human			Industrial			
																Private			Private		
			Municipal	Spring	Well	Stream	Fountain	Individual Cup	Common Cup	Wash Room	Shower	Common Towel	Other Towel	Individual Locker	Municipal	Dry	Water Carriage	Municipal	Stream	Other
All Industries	483	27,541	76.8	5.8	12.2	4.7	58.6	12.6	30.6	84.7	68.1	1.0	74.1	68.7	52.3	13.5	34.6	14.9	34.8	4.3
EXTRACTION OF MINERALS	98	9,329	71.7	9.1	12.0	4.6	21.1	19.0	65.6	90.5	87.4	0.5	87.6	76.3	68.5	26.0	7.8	.....	75.1	3.7
Coal Mines	23	1,009	3.6	3.7	60.1	2.3	18.7	90.4	10.0	89.4	85.5	.....	85.3	78.3	.....	91.1	6.6	.....	0.4	28.8
Metal Mines	61	7,897	82.9	9.5	2.5	5.1	20.7	10.4	71.6	93.6	89.4	0.6	89.7	79.4	80.8	14.7	7.4	.....	88.6	0.7
Quarries	7	103	21.4	28.2	38.8	.....	.....	39.8	60.2	.....	25.2	.....	25.2	.....	.....	100.0	.....	.....	.....	.....
Oil and Gas Wells	7	320	25.3	8.1	84.1	.....	44.1	.....	96.6	46.6	64.1	.....	64.1	17.5	3.4	74.1	22.5	.....	.....	.....
MANUFACTURING AND MECHANICAL INDUSTRIES	280	16.362	77.2	4.7	13.4	5.3	80.4	8.0	11.2	82.9	61.0	0.8	67.9	68.3	38.5	7.8	53.1	18.8	15.6	5.1
Chemical and Allied Industries	14	805	52.3	2.4	26.6	29.8	65.8	31.6	2.6	97.1	67.5	.....	67.5	67.7	40.6	6.3	53.0	1.5	55.2	16.3
Clay, Glass & Stone Industries	21	294	65.3	.....	34.7	15.3	64.3	1.4	30.6	24.1	33.0	4.4	19.7	21.1	12.6	62.2	23.1	.....	4.4	.....
Clothing Industries	4	44	100.0	.....	.....	.....	45.5	47.7	6.8	100.0	45.5	34.1	59.1	.....	100.0	.....	34.1	34.1	.....	.....
Food and Allied Industries	93	3,823	66.8	2.4	19.8	8.7	72.8	10.8	13.1	83.8	75.7	2.2	81.4	73.7	63.4	0.5	33.8	40.5	51.5	.....
Iron and Steel Industries	65	3,896	78.3	2.2	13.7	5.5	96.6	4.1	3.5	94.4	51.5	0.3	61.7	82.3	48.6	0.4	50.8	17.6	1.2	16.0
Metal Industries Except Iron & Steel	10	3,876	99.9	.....	.....	.....	97.9	.....	.....	100.0	97.4	.....	97.9	97.4	10.6	.....	89.4	6.5	2.1	.....
Leather Industries	6	32	100.0	.....	.....	.....	.....	84.4	15.6	100.0	.....	12.5	87.5	.....	100.0	.....	.....	12.5	.....	.....
Lumber Industries	23	2,507	55.4	22.4	23.1	1.1	55.7	7.0	37.3	37.5	15.2	.....	10.3	9.6	5.3	40.2	54.4	2.4	.....	.....
Paper, Printing and Allied Industries	24	824	100.0	.....	.....	.....	64.6	29.2	7.4	92.5	14.0	0.6	89.0	41.9	99.8	.....	.....	51.0	.....	9.1
Textile Industries	7	23	78.3	.....	.....	.....	.....	30.4	47.8	52.2	.....	.....	17.4	.....	91.3	.....	.....	.....	.....	.....
Miscellaneous Manufacturing Industries	13	238	95.8	.....	4.2	.....	62.6	1.7	31.5	68.9	62.6	.....	62.6	77.7	62.2	1.3	34.0	38.2	.....	.....
TRANSPORTATION AND COMMUNICATION	67	944	98.0	.....	0.8	.....	53.4	24.6	22.9	74.3	14.8	7.2	56.5	33.6	92.7	0.8	4.0	34.5	1.0	.....
PERSONAL SERVICE	35	774	100.0	.....	3.4	.....	49.2	20.5	33.6	64.3	44.1	4.5	60.7	21.3	99.2	.....	5.3	89.9	2.5	.....
NOT SPECIFIED INDUSTRIES	3	132	100.0	.....	.....	.....	100.0	.....	.....	100.0	100.0	.....	100.0	100.0	69.7	.....	30.3	.....	.....	.....

TABLE 9—INDUSTRIAL HEALTH SERVICE PROVISIONS MADE AVAILABLE TO WORKERS IN PLANTS EMPLOYING MORE THAN 100 WORKERS AS COMPARED WITH PLANTS EMPLOYING 100 WORKERS OR LESS (ALL SURVEYED INDUSTRIES)

Kind of Service	Number of workers receiving specified service in plants with—		Percent of workers receiving specified service in plants with—	
	More than 100 workers	100 workers or less	More than 100 workers	100 workers or less
Total Number and Percent of workers	19,064	8,477	69.2	30.8
SAFETY PROVISIONS				
Safety director, full time	9,501	57	49.8	0.7
Safety director, part time	4,077	1,898	21.4	22.4
Shop committee	10,319	1,610	54.1	19.0
Insurance service	4,586	1,859	24.1	21.9
Other safety provisions	16,629	6,911	87.2	81.5
MEDICAL PROVISIONS				
Hospital:				
Company	1,114	.....	5.8	.....
Contract	12,929	1,734	67.8	20.5
First aid room	5,310	590	27.9	7.0
First aid kit	18,510	7,448	97.1	87.9
First aid workers, trained	15,521	2,796	81.4	33.0
Physician, full time	799	53	4.2	0.6
Physician, part time	1,271	72	6.7	0.8
Physician, on call	15,549	2,510	81.5	29.6
Nurse, full time	1,620	408	19.0	4.8
Nurse, part time	1,023	362	5.4	4.3
Pre-employment physical examination	4,403	762	23.1	9.0
Periodical physical examination	2,591	399	13.6	4.7
DISABILITY STATISTICS				
Sick benefit organization	3,902	937	20.1	11.1
Sickness records	2,890	738	15.2	8.7
Accident records	18,781	6,779	98.5	80.0
SANITARY PROVISIONS				
Water supply:				
Municipal	14,647	6,486	76.3	76.5
Private:				
Spring	507	1,099	2.7	13.0
Well	2,408	937	12.6	11.1
Stream	961	326	5.0	3.8
Drinking facilities:				
Fountain	12,185	3,956	63.9	46.7
Individual cup	1,465	2,006	7.7	23.7
Common cup	6,204	2,233	32.5	26.3
Washing facilities:				
Wash room	17,534	5,801	92.0	68.4
Shower	14,635	4,109	76.8	48.5
Common towel	.....	287	.....	3.4
Other towel	15,467	4,951	81.1	58.4
Individual locker	15,419	3,493	80.9	41.2
Waste disposal:				
Human:				
Municipal	9,465	4,952	49.6	58.4
Private:				
Dry	1,955	1,755	10.3	20.7
Water carriage	7,792	1,745	40.9	20.6
Industrial:				
Municipal	1,738	2,368	9.1	27.9
Private:				
Stream	8,806	780	46.2	9.2
Other	649	531	3.4	6.3

FIGURE 4

INDUSTRIAL HEALTH SERVICE PROVISIONS IN PLANTS EMPLOYING MORE THAN 100 WORKERS AS COMPARED WITH PLANTS EMPLOYING 100 WORKERS OR LESS

PERCENT OF WORKERS
0 10 20 30 40 50 60 70 80 90 100
SAFETY DIRECTOR - FULL TIME
SAFETY DIRECTOR - PART TIME
SHOP COMMITTEES
INSURANCE SERVICE
OTHER SAFETY PROVISIONS
HOSPITAL - COMPANY
HOSPITAL - CONTRACT
FIRST-AID ROOM
FIRST-AID KIT
TRAINED FIRST-AID WORKER
PHYSICIAN - FULL TIME
PHYSICIAN - PART TIME
NURSE - FULL TIME
NURSE - PART TIME
PRE-EMPLOYMENT PHYSICAL EXAM.
PERIODICAL PHYSICAL EXAM.
SICK BENEFIT ORGANIZATION
SICKNESS RECORDS
ACCIDENT RECORDS
PERCENT OF WORKERS IN PLANTS EMPLOYING MORE THAN 100 WORKERS
PERCENT OF WORKERS IN PLANTS EMPLOYING 100 WORKERS OR LESS

GENERAL CONSIDERATION OF HEALTH PROVISIONS

Table 9 and figure 4 show a comparison between industrial health services provided in plants of more than 100 workers with plants having 100 workers or less. In general, all facilities considered were more commonly provided by the large plant. It does not follow, however, that these services were sufficient even in the large plants as no attempt was made to study and evaluate the services, but only to ascertain whether or not they were provided. Even if these services should be found to be adequate, there is still a large percentage of the workers in Montana who are not provided with them.

Table 10 and figure 5 show the comparison of industrial health services available to workers in Montana with those avilable to the workers studied in the 15 States survey. In general, it will be noted that the percentage of workers provided with health service provisions in Montana is less than in the 15 States survey.

The percentages of workers having available other safety provision and hospital facilities are notable exceptions to this statement. The former facility was available to 85.5 percent of the workers in this study. This high percentage can be explained by the fact that the figure includes workers having available the facilities of the Montana Industrial Accident Board which is required by statute. The 15 States survey percentage of 41.7 did not include workers covered by industrial accident commissions or similar State agencies. The percentage of workers in this study (57.4 percent) having available the facilities of a hospital is considerably higher than that for the 15 States (15.1 percent). This is largely attributable to the high percentage of workers provided with this facility in the extraction of minerals (75.8 percent), metal except iron and steel (65.5 percent) and lumber industries (76.4 percent).

It will be noted in table 10 that the services of a full time safety director were available to 34.7 percent of the workers in this study. This is higher than that for the 15 States survey (25.6 percent) but may be accounted for by the fact that the metal mine and metal except iron and steel industries have a particularly high percentage of their workers served by full time directors.

This table and figure 5 strikingly present the lack of services of physicians and nurses in the industries of Montana as compared with the 15 States. Sick benefit organizations are less common in Montana than in the 15 States and sickness records are available to a much smaller percentage of the industrial population.

Information on pre-employment and periodical physical examinations is not available for the 15 States and, therefore, no comparison can be made.

TABLE 10—COMPARISON OF INDUSTRIAL HEALTH SERVICES IN MONTANA INDUSTRIES WITH SIMILAR DATA FROM A SURVEY OF 15 OTHER STATES

Kind of Service	Percentage of workers with indicated service	
	15 States[1]	Montana
SAFETY PROVISIONS		
Safety director, full time	25.6	34.7
Safety director, part time	25.2	21.7
Shop committee	50.9	43.3
Insurance service	{	23.4
Other safety provisions	{ 41.7	85.5
MEDICAL PROVISIONS		
Hospital:	15.1	57.4
Company	.....	4.2
Contract	.....	53.2
First aid room	51.0	21.4
First aid kit	91.3	94.3
Trained first aid worker	47.5	66.5
Physician, full time	15.5	3.1
Physician, part time	22.3	6.2
Nurse, full time	33.3	14.6
Nurse, part time	1.5	5.0
Pre-employment physical examination	.....	18.8
Periodical physical examination	.....	10.9
DISABILITY STATISTICS		
Sick benefit organizations	41.6	17.6
Sickness records	45.4	13.2
Accident records	94.0	92.8

[1] Public Health Bulletin No. 259.

FIGURE 5

PERCENTAGE OF WORKERS RECEIVING CERTAIN HEALTH PROVISIONS IN MONTANA INDUSTRIES AS COMPARED WITH THE 15 STATES SURVEY

EXPOSURES TO SPECIFIED MATERIALS

In order to obtain information concerning the number of potential exposures in each industrial group, it was necessary to list all raw materials and by-products encountered in each plant. In collecting the field data of the study, all such materials were listed by each occupation in each plant surveyed regardless of whether or not the material was thought to be harmful. Since there are over 500 materials which are known to be injurious under certain conditions and since this number is increasing rapidly as new processes are introduced into industry, it was necessary for the purpose of tabulation to combine many of the similar materials under one group. Materials were therefore classified into 47 of these major groups which include each material encountered having a potential menace to the health of workers. It must be emphasized that in this study no attempt was made to conduct quantitative measurements as to the extent of exposure to the workers, but merely to indicate the potential health hazard present. It must be borne in mind, however, that the pathological affect of a material will vary with the quantity present, period of time the worker is exposed, control measures used and the individual susceptibility of the worker. These data indicate where lost time from industry due to occupational illness may be expected to occur and where more detailed studies should be conducted.

Tables 11 and 12 show the number and percent of workers respectively, exposed to the various materials in each industry group surveyed, in order of decreasing number. Because a worker may have been exposed to a number of materials, the total number of exposures appearing in this table will necessarily be more than the total number of workers exposed. In this study silica dust accounted for the largest number of potential exposures.

Among the most important material exposures found were those to various metals. The other metals group, which includes iron, copper, tin and aluminum, has the sixth highest number of exposures as shown in table 11 but is not as important as some of the more toxic metals such as arsenic, antimony, manganese, lead, zinc, mercury, cadmium and chrominum, which are listed separately. Although lead and manganese do not hold a commanding position in number of exposures, they do present important problems from the standpoint of occupational illness.

A similar discussion might well be presented for gases since this report includes a classification termed other gases. The latter does not include the more toxic gases such as carbon monoxide, sulfur dioxide, cyanide, hydrogen sulfide, and oxides of nitrogen, which are listed separately. Exposure to carbon monoxide is a common cause for lost time and since this material is listed seventh in number of exposures, it warrants further study.

Exposures to high humidity which is second on this list and to extreme temperature change which is fifth, in themselves, do not appear to be particularly harmful to workers. Brundage (7), however, has shown that

TABLE 11—NUMBER OF WORKERS IN EACH INDUSTRY OR SERVICE GROUP EXPOSED TO SPECIFIED MATERIALS

Materials	Number of Workers Exposed															
	All Surveyed Industries	Extraction of Minerals	Chemical and Allied	Clay, Glass and Stone	Clothing	Food and Allied	Iron and Steel	Metal Industries Except Iron and Steel	Leather	Lumber	Paper, Printing and Allied	Textile	Miscellaneous Manufacturing	Transportation	Personal Service	Not Specified
Number of workers in surveyed industries	27,541	9,329	805	294	44	3,823	3,896	3,876	32	2,507	824	23	238	944	774	132
Total number of exposures	79,688	49,170	2,053	683	96	4,846	7,180	9,627	53	1,192	1,225	27	267	1,733	1,276	260
Silica dust	7,670	6,708	92	210	.....	87	133	392	.....	.....	.....	.....	18	.....	.....	30
High humidity	7,550	5,581	56	.....	.....	1,060	8	330	1	13	.....	.....	19	5	477	.....
Other gases (N.O.S.)*	7,401	3,509	146	48	2	773	1,494	1,020	.....	41	126	.....	30	169	43	.....
Silicate dust	7,376	6,574	105	178	.....	33	18	419	.....	.....	.....	.....	19	.....	.....	30
Extreme temperature changes	7,342	5,460	106	12	.....	348	229	799	.....	46	7	.....	36	5	279	5
Other metals (N.O.S.)*	7,330	5,879	19	.....	.....	.....	202	1,144	.....	6	22	.....	24	4	.....	30
Carbon monoxide	7,035	3,472	112	48	.....	542	1,181	961	.....	49	100	.....	16	504	42	8
Petroleum products	3,849	656	351	48	.....	197	1,770	142	1	69	99	4	12	416	50	34
Oils, fats and waxes	3,445	3,097	12	2	.....	212	88	4	.....	11	.....	.....	.....	.....	19	.....
Acids, mineral	3,290	2,180	178	6	.....	54	13	844	.....	.....	5	.....	.....	6	3	3
Lead	3,194	1,491	69	.....	.....	.....	260	954	.....	10	309	.....	24	47	.....	30
Zinc	2,295	1,373	.....	.....	.....	.....	32	850	.....	10	.....	.....	.....	.....	.....	30
Organic dust	1,608	77	.....	.....	25	353	197	50	20	846	25	13	.....	.....	2	.....
Oxides of Nitrogen	1,455	575	47	8	.....	21	658	3	.....	1	6	.....	.....	136	.....	.....
Defective illumination	1,289	857	.....	2	.....	98	66	49	3	11	21	3	1	41	137	.....
Oth. dermatitis producers (N.O.S.)	878	142	5	.....	.....	310	214	149	5	17	35	.....	1	.....	.....	.....
Coal dust, bituminous	831	829	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Other organic solvents (N.O.S.)*	819	97	392	1	1	1	99	19	3	4	3	.....	5	118	76	.....
Sulfur dioxide	672	.....	89	.....	.....	206	.....	377	.....	.....	.....	.....	.....	.....	.....	.....
Non-siliceous dust	648	190	.....	101	.....	197	50	73	.....	7	.....	.....	2	.....	1	27
Arsenic	556	98	.....	.....	18	.....	.....	429	.....	11	.....	.....	.....	.....	.....	.....
Antimony	465	4	.....	.....	.....	.....	.....	153	.....	.....	305	.....	.....	3	.....	.....
Manganese	366	57	.....	.....	.....	.....	.....	282	.....	.....	.....	.....	.....	.....	.....	27
Paint and enamel	364	1	20	1	.....	1	179	19	1	11	.....	.....	19	112	.....	.....
Alkalies	352	58	48	.....	.....	97	32	63	.....	.....	.....	.....	8	1	42	3
Other chemicals (N.O.S.)*	306	42	56	11	.....	69	53	42	.....	11	1	.....	14	4	.....	3
Alcohols, esters and ethers	226	.....	3	1	.....	.....	87	2	2	3	27	.....	5	91	5	.....
Phosphorous	145	43	102	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ink	124	.....	.....	.....	1	.....	.....	.....	.....	.....	123	.....	.....	.....	.....	.....
Cyanide	112	74	.....	.....	.....	.....	38	.....	.....	.....	.....	.....	.....	.....	.....	.....
Other coal tar products (N.O.S.)*	105	7	.....	.....	.....	.....	36	.....	.....	11	.....	.....	.....	1	50	.....
Organic acids	92	27	10	6	.....	46	.....	.....	.....	.....	.....	.....	.....	.....	3	.....
Lacquer and varnish	92	.....	.....	.....	.....	.....	6	2	4	4	.....	.....	6	70	.....	.....
Hides	59	.....	.....	.....	.....	52	7	.....	.....	.....	.....	.....	.....	.....	.....	.....
Halogenated hydrocarbons	48	.....	.....	.....	4	.....	.....	.....	.....	.....	4	.....	.....	.....	40	.....
Salt	47	.....	.....	.....	.....	35	7	.....	.....	.....	.....	.....	5	.....	.....	.....
Dyes	46	.....	12	.....	10	.....	.....	.....	13	.....	.....	7	.....	.....	4	.....
Hydrogen Sulfide	41	.....	15	.....	.....	.....	.....	26	.....	.....	.....	.....	.....	.....	.....	.....
Chlorine	38	.....	.....	.....	.....	35	.....	.....	.....	.....	.....	.....	.....	.....	3	.....
Infections	34	.....	.....	.....	17	17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mercury	33	12	.....	.....	18	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	.....
Cadmium	30	.....	.....	.....	.....	.....	.....	30	.....	.....	.....	.....	.....	.....	.....	.....
Aldehydes	15	.....	.....	.....	.....	2	13	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sulfur	7	.....	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Benzol	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	.....	.....	.....	.....	.....
Asbestos dust	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Chromium	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....

*Not Otherwise Specified.

TABLE 12—PERCENT OF WORKERS IN EACH INDUSTRY OR SERVICE GROUP EXPOSED TO SPECIFIED MATERIALS

Materials	Percent of Workers Exposed															
	All Surveyed Industries	Extraction of minerals	Chemical and Allied	Clay, Glass and Stone	Clothing	Food and Allied	Iron and Steel	Metal Industries Except Iron & Steel	Leather	Lumber	Paper, Printing and Allied	Textile	Misc. Manuf.	Transportation	Personal Service	Not Specified
Number of workers in surveyed industries	27,541	9,329	805	294	44	3,823	3,896	3,851	32	2,507	824	23	238	944	764	132
Silica dust	27.8	71.9	11.4	71.4	.....	1.8	3.4	10.2	.....	.....	.....	.....	7.6	.....	.....	22.7
High humidity	27.4	59.8	7.0	.....	.....	21.9	0.2	8.7	3.0	0.5	.....	.....	8.0	0.5	62.7	.....
Other gases (N.O.S.)*	26.9	37.6	18.1	16.3	4.5	16.0	38.3	26.5	.....	1.6	15.3	.....	12.6	17.9	5.6	.....
Silicate dust	26.8	70.5	13.0	60.5	.....	0.7	0.5	10.9	.....	.....	.....	.....	8.0	.....	.....	22.7
Extreme temperature changes	26.7	58.5	13.2	4.1	.....	7.2	6.1	20.7	.....	1.8	0.9	.....	15.1	0.5	36.5	3.8
Other metals (N.O.S.)*	26.6	63.0	2.4	.....	.....	.....	5.2	29.7	.....	0.2	2.7	.....	10.1	0.4	.....	22.7
Carbon monoxide	25.5	37.2	13.9	16.3	.....	11.2	30.3	25.0	.....	2.0	12.1	.....	6.7	53.4	5.5	6.1
Petroleum products	14.0	7.0	43.6	16.3	.....	4.1	45.4	2.7	3.0	2.8	12.0	17.4	5.0	44.1	5.5	25.8
Oils, fats and waxes	12.5	33.2	1.5	0.7	.....	4.4	2.3	0.1	.....	0.4	.....	.....	.....	.....	2.5	.....
Acids, mineral	11.9	23.4	22.2	2.0	.....	1.1	0.3	21.9	.....	.....	0.6	.....	.....	0.6	0.4	2.3
Lead	11.6	16.0	8.6	.....	.....	.....	6.7	24.8	.....	0.4	37.5	.....	10.1	5.0	.....	22.7
Zinc	8.3	14.7	.....	.....	.....	.....	0.8	22.1	.....	0.4	.....	.....	.....	.....	.....	22.7
Organic dust	5.8	0.8	.....	.....	56.8	8.3	5.1	1.3	62.5	33.7	3.0	56.5	.....	.....	0.3	.....
Oxides of nitrogen	5.3	6.2	5.8	2.7	.....	0.4	16.9	0.1	.....	0.0	0.7	.....	.....	14.4	.....	.....
Defective illumination	4.7	9.2	.....	0.7	.....	2.0	0.9	1.3	9.4	0.4	2.5	13.0	0.4	4.3	17.9	.....
Oth. dermatitis producers (N.O.S.)*	3.2	1.5	0.6	.....	.....	6.4	5.5	3.9	15.6	0.7	4.3	.....	0.4	.....	.....	.....
Coal dust, bituminous	3.0	8.9	.....	.....	.....	.....	0.1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Other organic solvents (N.O.S.)*	3.0	1.0	48.7	0.3	2.3	0.0	2.5	0.5	9.4	0.2	0.4	.....	2.1	12.5	9.9	.....
Sulfur dioxide	2.4	.....	11.1	.....	.....	4.3	.....	9.8	.....	.....	.....	.....	.....	.....	.....	.....
Non-siliceous dust	2.4	2.0	.....	34.4	.....	4.1	1.3	1.9	.....	0.3	.....	.....	0.8	.....	0.1	20.5
Arsenic	2.0	1.1	.....	.....	40.9	.....	.....	11.1	.....	0.4	.....	.....	.....	.....	.....	.....
Antimony	1.7	0.0	.....	.....	.....	.....	.....	4.0	.....	.....	37.0	.....	.....	0.3	.....	.....
Manganese	1.3	0.6	.....	.....	.....	.....	.....	7.3	.....	.....	.....	.....	.....	.....	.....	20.5
Paint and enamel	1.3	0.0	2.5	0.3	.....	0.0	5.1	0.5	3.0	0.4	.....	.....	8.0	11.9	.....	.....
Alkalies	1.3	0.6	6.0	.....	.....	2.0	0.8	1.6	.....	.....	.....	.....	3.4	0.1	5.5	2.3
Other chemicals (N.O.S.)*	1.1	0.5	7.0	3.7	.....	1.4	1.4	1.1	.....	0.4	0.1	.....	5.9	0.4	.....	2.3
Alcohols, esters and ethers	0.8	.....	0.4	0.3	.....	.....	2.2	0.1	6.3	0.1	3.3	.....	2.1	9.6	0.6	.....
Phosphorous	0.5	0.5	12.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ink	0.5	.....	.....	.....	2.3	.....	.....	.....	.....	.....	14.9	.....	.....	.....	.....	.....
Cyanide	0.4	0.8	.....	.....	.....	.....	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....
Other coal tar products (N.O.S.)*	0.4	0.1	.....	.....	.....	.....	0.9	.....	.....	0.4	.....	.....	.....	0.1	6.5	.....
Acids, organic	0.3	0.3	1.2	2.0	.....	1.0	.....	.....	.....	.....	.....	.....	.....	.....	0.4	.....
Lacquer and varnish	0.3	.....	.....	.....	.....	.....	0.2	0.1	12.5	0.2	.....	.....	2.5	7.4	.....	.....
Hides	0.2	.....	.....	.....	.....	1.1	0.2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Halogenated hydrocarbons	0.2	.....	.....	.....	9.1	.....	.....	.....	.....	.....	0.5	.....	.....	.....	5.2	.....
Salt	0.2	.....	.....	.....	.....	0.7	0.2	.....	.....	.....	.....	.....	2.1	.....	.....	.....
Dyes	0.2	.....	1.2	.....	23.0	.....	.....	.....	40.6	.....	30.4	.....	.....	.....	0.5	.....
Hydrogen sulfide	0.1	.....	1.9	.....	.....	.....	.....	0.7	.....	.....	.....	.....	.....	.....	.....	.....
Chlorine	0.1	.....	.....	.....	.....	0.7	.....	.....	.....	.....	.....	.....	.....	.....	0.4	.....
Infections	0.1	.....	.....	.....	38.6	0.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mercury	0.1	0.1	.....	.....	40.9	.....	.....	.....	.....	.....	.....	.....	1.3	.....	.....	.....
Cadmium	0.1	.....	.....	.....	.....	.....	.....	0.8	.....	.....	.....	.....	.....	.....	.....	.....
Aldehydes	0.1	.....	.....	.....	.....	0.0	0.3	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sulfur	0.0	.....	0.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Benzol	0.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.7	.....	.....	.....	.....	.....
Asbestos dust	0.0	.....	0.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Chromium	0.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.1	.....	.....	.....	.....	.....

*Not Otherwise Specified.

workers exposed to extreme temperature change have a far greater pneumonia rate than those not so exposed. Likewise, exposure to high humidity may cause a high incidence of common colds which is an important cause of lost time. The unusually high incidence (12.5 percent) of exposure to oils, fats and waxes is accounted for by the fact that in this study all miners using air line oil lubrication were given exposures to these materials because of the oil mist which occurs.

Dermatitis producers and certain other specified materials which are irritating to the skin, (petroleum products, oils, fats and waxes, acids, organic dusts, organic solvents and many others) create a major problem. Experience in other States has been that well over 50 percent of the reported cases of occupational diseases are dermatitis, which is responsible for a high percentage of lost time.

Briefly the above may be summarized by stating that the most serious exposure problems in the State occur from silica dust, metal dusts, fumes and gases. Although number of exposures is important in the evaluation of the industrial hygiene problems of a State, it does not necessarily give a true picture. For example, more pathology may occur among the 3,194 exposures to lead than among the 7,330 exposures to other metals. Thus, the relative importance of these materials from the standpoint of toxicity must be considered as well as the number of exposures.

EXPOSURE TO MATERIALS IN EACH INDUSTRY GROUP

Among the many occupational diseases receiving special attention today are the dermatoses, silicosis, lead poisoning, and carbon monoxide poisoning. Reference to table 11 will show the large number of exposures to materials capable of producing these diseases. A brief discussion of exposures to specified materials in each industry group follows. The tabulated information in each industry group is in table 13 which is a summary of tables 11 and 12 and presents only those material exposures affecting 10 per cent or more of the workers.

EXTRACTION OF MINERALS

Extraction of minerals consisting of coal mines, metal mines, quarries and oil and gas wells had 9,329 workers of which 71.9 percent or 6,708 workers were exposed to silica dust and 70.5 percent or 6,574 to silicate dusts. Other important material exposures in these industries were to other metals, high humidity, extreme temperature change, lead, and carbon monoxide. Carbide lamps used in underground mining operations were considered inadequate lighting. All miners using carbide lamps were, therefore, given exposure to defective illumination. Of the workers in this industry group 9.2 percent were so affected.

TABLE 13—MATERIALS IN EACH INDUSTRY OR SERVICE GROUP TO WHICH 10 PERCENT OR MORE WORKERS WERE EXPOSED

Industry or Service Group	Materials	Exposed Workers	
		Percent	Number
Extraction of Minerals (9,329 workers)			
	Silica dust	71.9	6,708
	Silicate dust	70.5	6,574
	Other metals (N.O.S.)*	63.0	5,879
	High humidity	59.8	5,581
	Extreme temperature changes	58.5	5,460
	Other gases (N.O.S.)*	37.6	3,509
	Carbon monoxide	37.2	3,472
	Lead	16.0	1,491
	Zinc	14.7	1,373
	Oils, fats and waxes	12.5	3,097
	Acids, mineral	11.9	2,180
Chemical and Allied (805 workers)			
	Other organic solvents (N.O.S.)*	48.7	392
	Petroleum products	43.6	351
	Acids, mineral	22.2	178
	Other gases (N.O.S.)*	18.1	146
	Carbon monoxide	13.9	112
	Extreme temperature changes	13.2	106
	Silicate dust	13.0	105
	Phosphorous	12.7	102
	Silica dust	11.4	92
	Sulfur dioxide	11.1	89
Clay, Glass and Stone (294 workers)			
	Silica dust	71.4	210
	Silicate dust	60.5	178
	Non-siliceous dusts	34.4	101
	Carbon monoxide	16.3	48
	Other gases (N.O.S.)*	16.3	48
	Petroleum products	16.3	48
Clothing (44 workers)			
	Organic dust	56.8	25
	Arsenic	40.9	18
	Mercury	40.9	18
	Infections	38.6	17
Iron and Steel (3,896 workers)			
	Petroleum products	45.4	1,770
	Other gases (N.O.S.)*	38.3	1,494
	Carbon monoxide	30.3	1,181
	Oxides of nitrogen	16.9	658
Metals other than Iron & Steel (3,851 workers)			
	Other metals (N.O.S.)*	29.7	1,144
	Other gases ,N.O.S.)*	26.5	1,020
	Carbon monoxide	25.0	961
	Lead	24.8	954
	Zinc	22.1	850
	Acids, mineral	21.9	844
	Extreme temperature changes	20.7	799
	Arsenic	11.1	429
	Silicate dust	10.9	419
	Silica dust	10.2	392
Leather (32 workers)			
	Organic dust	62.5	20
	Dye	40.6	13
	Other dermatitis producers (N.O.S.)*	15.6	5
	Lacquer and varnish	12.5	4
Lumber (2,507 workers)			
	Organic dust	33.7	846
Paper, Printing and Allied (824 workers)			
	Lead	37.5	309
	Antimony	37.0	305
	Other gases (N.O.S.)*	15.3	126
	Ink	14.9	123
	Carbon monoxide	12.1	100
	Petroleum products	12.0	99
Textiles (23 workers)			
	Organic dust	56.5	13
	Dyes	30.4	7
	Petroleum products	17.4	4
	Defective illumination	13.0	3

*Not Otherwise Specified.

TABLE 13—MATERIALS IN EACH INDUSTRY OR SERVICE GROUP TO WHICH 10 PERCENT OF MORE WORKERS WERE EXPOSED—(Continued)

Industry or Service Group	Materials	Exposed Workers	
		Percent	Number
Miscellaneous Manufacturing Industries (238 workers)	Extreme temperature changes	15.1	36
	Other gases (N.O.S.)*	12.6	30
	Lead	10.1	24
	Other metals (N.O.S.)*	10.1	24
Transportation and Communication (944 workers)	Carbon monoxide	53.4	504
	Petroleum products	44.1	416
	Other gases (N.O.S.)*	17.9	169
	Oxides of nitrogen	14.4	136
	Other organic solvents (N.O.S.)*	12.5	118
	Paint and enamel	11.9	112
Personal Service (764 workers)	High humidity	62.7	479
	Extreme temperature changes	36.5	279
	Defective illumination	17.9	137
Not Specified Industries and Services (132 workers)	Petroleum products	25.8	34
	Silica dust	22.7	30
	Silicate dust	22.7	30
	Lead	22.7	30
	Zinc	22.7	30
	Other metals (N.O.S.)*	22.7	30
	Non-siliceous dusts	20.5	27
	Manganese	20.5	27

*Not Otherwise Specified.

CHEMICAL AND ALLIED

The chemical and allied industries in this study include fertilizer, paint and varnish factories, petroleum refineries and other chemical industries. Because of the variety of plants, a wide diversity of material exposures may be expected in this industry group. This is confirmed by the fact that there are 10 materials in this industry to which 10 percent or more of the workers were exposed. Organic solvents and petroleum products lead the list of exposures in this industry with 48.7 percent and 43.6 percent respectively. The petroleum refineries account for the larger part of these exposures. Other important exposures in this group were to mineral acids, other gases and carbon monoxide. It will be noted that 12.7 percent of the workers in this industry group were exposed to phosphorus which exposures were limited almost entirely to the fertilizer industry. This is a typical example of how one particular industry may affect the exposures of a rather large industry group.

CLAY, GLASS AND STONE

The clay, glass and stone industry is composed of brick and tile, lime, cement and artificial stone, and marble and stone factories. In number of workers this is a relatively small industry, but from the standpoint of occupational exposures, it is not to be overlooked since 71.4 percent of the workers were exposed to silica dust. Other important material exposures in this group were to silicate and non-siliceous dusts, carbon monoxide, other gases and petroleum products.

CLOTHING

The clothing industry in this State is composed entirely of small plants, the majority of which are excluded from this study because of size. For this reason, only 44 workers were surveyed. The chief exposure in this group was to organic dusts, to which 56.8 percent of the workers surveyed were exposed. Other important exposures were to arsenic, mercury and infectious materials.

FOOD AND ALLIED

The food industry in Montana consists of creamery, meat packing, sugar refining, fruit and vegetable canning, liquor and beverage, and certain miscellaneous plants, bakeries and flour and grain mills. As has been shown previously in this report, many of the plants in this industry were small and the materials to which workers were exposed varied widely.

There were only 3 materials to which more than 10 percent of the workers were exposed, namely, high humidity 21.9 percent, other gases 16.0 percent and carbon monoxide 11.2 percent.

IRON AND STEEL

This industry group is composed of car and railroad shops, foundries, machine shops, and miscellaneous iron and steel plants with the railroad shops predominating in number of workers. The chief exposure was to petroleum products (oil, grease and cutting oils) which are important dermatitis producers. Of the workers in this industry, 45.4 percent were exposed to these materials. Other important exposures were 38.3 percent to other gases, 30.3 percent to carbon monoxide, and 16.9 percent to oxides of nitrogen.

METALS OTHER THAN IRON AND STEEL

This group includes brass, copper, lead and zinc, and other metal factories, and constitutes one of the major industries of Montana due to extensive smeltering and refining operations.

Exposures to metallic dusts predominate in this industry, involving 29.7 percent of the 3,851 workers surveyed. Exposures to other gases and carbon monoxide involved 26.5 percent and 25.0 percent of the workers respectively. Other important exposures were 24.8 percent to lead, 22.1 percent to zinc and 11.1 percent to arsenic. More than 10 percent of the workers were also exposed to mineral acids, silica and silicate dusts and extreme temperature change. The importance of extreme temperature change as an exposure in this industry is related to its association with the incidence of pneumonia among iron and steel workers (7).

LEATHER

The leather industry, employing very few workers in Montana, is one of the State's minor industries. There were, however, certain materials

to which leather workers were exposed which are important from the standpoint of occupational illness. Of the workers in this industry, 62.5 percent were exposed to organic dust, 40.6 percent to dyes, 15.6 percent to dermatitis producers and 12.5 percent to lacquers.

LUMBER

The lumber industry in Montana consists chiefly of saw and planing mills and other woodworking factories. Exposures in this industry involved 21 of the 47 listed materials. Most frequent exposures were to organic dusts, (33.7 percent). Exposures to certain other materials affecting a rather small percentage of the workers may prove to be important from the standpoint of occupational disease. Examples of such materials are carbon monoxide, arsenic, paint, dermatitis producers and coal tar products.

PAPER, PRINTING AND ALLIED

This industry is comprised chiefly of newspaper and job printing establishments many of which are engaged to some extent in binding. The chief exposures were to lead and antimony with 37.5 percent and 37.0 percent respectively of workers exposed. This large number of exposures to these materials makes them a particularly serious problem in this industry. Other gases and carbon monoxide were also important exposures as well as ink to which 14.9 percent of the workers were exposed and which is a common producer of dermatitis.

TEXTILE

Textile, like clothing, is a very small industry in this State, only 23 workers having been surveyed. The total number of exposures occurring in this industry was small, howver, 56.5 percent were exposed to organic materials and 30.4 percent to dye. Other materials to which over 10 percent of the workers were exposed were petroleum products and defective illumination.

MISCELLANEOUS MANUFACTURING

This group is made up of plants which do not logically fall within any of the classifications of the manufacturing and mechanical industries. It includes such industries as electric light and power plants, electrical machinery and supply factories and cold storage plants in which 238 workers were surveyed. Of the 20 material exposures, extreme temperature change (15.1 percent), other gases (12.6 percent), lead (10.1 percent), and other metals (10.1 percent) were among the most important. Other gases, to which 12.6 percent of the workers were exposed, includes various commonly used refrigerants some of which are known to be highly toxic.

TRANSPORTATION AND COMMUNICATION

Under transportation only one group of industries was chosen for study, namely, the automobile repair shops, garages, and automobile service

industry in which 944 workers were surveyed. The chief exposure was to carbon monoxide which involved 53.4 percent of all workers. Other important material exposures were to oil and grease (44.1 per cent), other gases (17.9 percent), oxides of nitrogen (14.4 percent), lead (5.0 percent), organic solvents (12.5 percent), and paint (11.9 percent).

PERSONAL SERVICE

The only industries studied in this group were laundries, cleaning, dyeing and pressing shops. There were 764 workers surveyed and the chief material exposures were to high humidity (62.7 percent), extreme temperature change (36.5 percent) and defective illumination (17.9 percent) Other exposures of importance were to organic solvents, carbon monoxide, other gases, alkalies, coal tar products and halogenated hydrocarbons.

NOT SPECIFIED INDUSTRIES AND SERVICES

A few of the plants surveyed did not fall under any of the above industry classifications and were, for that reason, listed separately. There were 132 workers surveyed in these industries and the most important material exposures were to petroleum products, silica and silicate and non-siliceous dusts, lead, zinc, manganese and other metals.

MATERIAL EXPOSURES IN ALL INDUSTRIES

Table 12 (column I) summarizes the percent of workers exposed to the 47 potentially harmful materials considered in this survey. It will be seen that silica dust, with 27.8 percent of all workers studied, leads in the number of exposures. Exposures to extreme temperature change (27.4 percent) and high humidity (26.7 percent) appear to be very important in the industries of Montana. One-fourth (25.5 percent) of all workers surveyed were exposed to carbon monoxide. The harmful effects of carbon monoxide to workers are well known and further studies should be made to determine whether or not these workers are exposed to excessive quantities of the gas.

Among substances capable of producing dermatitis are listed oils, fats and waxes with 12.5 percent of the workers exposed, ink 0.5 percent, infections 0.1 percent, petroleum products 14.0 percent and other dermatitis producers 3.2 percent.

Exposures to lead, which have been referred to previously, constitute a very real problem in the industries in Montana since 11.6 percent of all workers surveyed were exposed to this toxic material.

Exposures to certain other materials are not discussed for purposes of simplicity, but on examination of table 12, it is apparent that there are many other materials which present definite health problems.

EXPECTED NUMBER OF WORKERS EXPOSED

To determine the total number of workers exposed to potentially harmful materials in this State would necessitate a tremendous amount of work and a large expenditure of funds. It does not seem that this is justifiable in lieu of the fact that the survey sample was both adequate in size and representative of the industries studied. Other surveys have shown representative samples to yield accurate data from which the expected number of workers exposed in the industries of a State may be calculated. This procedure was followed in this report and the resulting data are presented in table 14. This table lists the percentage of workers in the survey sample who were actually exposed to the specified materials and the number of workers who might be expected to be exposed to the same materials throughout the State. This was obtained by multiplying the entire working population as given in the 1930 Census (1) for the industries studied, by the percentage of workers actually exposed to these materials. These data are of definite value in formulating future studies for the protection of the health of industrial workers.

Column 11 of table 14 reveals that the total expected number of workers exposed to specified materials exceeds the total number of workers in the industries studied. This is due to the fact that one worker may be exposed to more than one material. For example, a painter in his usual work may be exposed to paint, varnish, lacquer and a variety of organic solvents.

From the expected number of workers exposed (table 14) it can be seen that a large number of occupational diseases may result from exposures to such potentially harmful materials as silica and silicate dusts, lead, manganese, antimony, arsenic, carbon monoxide, sulfur dioxide, organic solvents, dermatitis producers and others.

In summary, it is emphasized that the materials contributing the greatest number of exposures may not cause as much illness or as many deaths as materials contributing fewer exposures.

TABLE 14—EXPECTED NUMBER OF WORKERS IN SELECTED INDUSTRY GROUPS IN MONTANA EXPOSED TO SPECIFIED MATERIALS

Materials	Percent of workers exposed (survey) (I)	Expected number of workers exposed (II)
Number of workers surveyed (basis for percentage in column I)		27,541
Number of workers in selected industry groups in Montana (basis for expected number in column II)		89,241[1]
Silica dust	27.8	24,809
High humidity	27.4	24,452
Other gases (N.O.S.)*	26.9	24,005
Silicate dust	26.8	23,916
Extreme temperature changes	26.7	23,827
Other metals (N.O.S.)*	26.6	23,738
Carbon monoxide	25.5	22,756
Petroleum products	14.0	12,493
Oils, fats and waxes	12.5	11,155
Acids, mineral	11.9	10,619
Lead	11.6	10,352
Zinc	8.3	7,407
Organic dust	5.8	5,176
Oxides of nitrogen	5.3	4,730
Defective illumination	4.7	4,194
Other dermatitis producers (N.O.S.)*	3.2	2,856
Coal dust, bituminous	3.0	2,677
Other organic solvents (N.O.S.)*	3.0	2,677
Sulfur dioxide	2.4	2,142
Non-siliceous dust	2.4	2,142
Arsenic	2.0	1,785
Antimony	1.7	1,517
Manganese	1.3	1,160
Paint and enamel	1.3	1,160
Alkalies	1.3	1,160
Other chemicals (N.O.S.)*	1.1	982
Alcohols, esters and ethers	0.8	714
Phosphorous	0.5	446
Ink	0.5	446
Cyanide	0.4	357
Other coal tar products (N.O.S.)*	0.4	357
Acids, organic	0.3	268
Lacquer and varnish	0.3	268
Hides	0.2	178
Halogenated hydrocarbons	0.2	178
Salt	0.2	178
Dyes	0.2	178
Hydrogen sulfide	0.1	89
Chlorine	0.1	89
Infections	0.1	89
Mercury	0.1	89
Cadmium	0.1	89
Aldehydes	0.1	89
Sulfur	0.0	0
Benzol	0.0	0
Asbestos dust	0.0	0
Chromium	0.0	0

*Not Otherwise Specified.

[1] United States Census (1930).

CONTROL MEASURES

There are numerous satisfactory methods of controlling occupational health hazards which occur in industry due to exposure to toxic materials. The type of control measure varies with the material to be controlled. In selecting a means of controlling a given exposure, it is essential to know the nature of the material and its threshold limit. This limit represents the amount of the material to which workers may be exposed without experiencing harmful effect.

The general methods of control used in the industries of Montana are presented with the understanding that while one may be entirely satisfactory for a given material, it may be valueless as the control for another material. Conversely, each use of a harmful material in industry may require an entirely different method of control. The principal methods of control for hazardous materials in industry are:

1. Substitution of a non-toxic material for a toxic one.
2. Isolation of the hazardous occupation from other occupations.
3. Applying local exhaust ventilation at the point of origin of the harmful material.
4. Enclosing the hazardous operation or process.
5. Use of wet methods.
6. Use of positive or negative ventilation.
7. Use of personal protective devices, such as:
   a. Respirators.
   b. Pressure helmets.
   c. Gas masks.
   d. Protective clothing.
   e. Protective creams, salves, or ointments.
8. Use of protective devices for the control of heat, noise, inadequate lighting and other harmful conditions.

In presenting the data on control measures used by the industries of the State of Montana, no attempt has been made to determine the adequacy of the control. This study presents only the exposures to the potentially harmful materials that occur in the various industries and the steps taken to control them. When an employer provided one or more of the above control measures, it is evident that he recognized the existence of a potential hazard and attempted to protect his employees. It has been observed that some of the controls provided were crude makeshifts while others were apparently well-designed and properly installed. An otherwise adequate control measure may be of little or no value unless properly used.

Tables 15 and 16 give the number of workers exposed to each potentially harmful material for all industries studied, and the number and percent of those having control measures available. It is interesting to note that 26.1 percent of the exposed workers had no control.

Of the 27,541 workers surveyed, there were 79,688 exposures which is approximately three times the number of workers studied. Likewise, the number of control measures exceeded the total number of workers studied, since a worker may have more than one control. This is revealed by the fact that 73.9 percent of the exposed workers accounted for all the control measures provided.

Table 16 shows that the most common control measures in use were positive ventilation (29.4 percent), negative ventilation (25.0 percent), and wet methods (22.9 percent). Of the 3,445 workers exposed to oils, fats and waxes, 73.0 percent were controlled by positive ventliation. This high percentage of controls is accounted for by the fact that a large number of miners using vegetable oil drill lubrication were given general positive ventilation.

The most commonly used measure for controlling carbon monoxide was positive general ventilation with which 35.4 percent of the workers were provided. However, it is striking to note that 23.5 percent of the workers exposed to this important toxic material had no control.

The industry in Montana generally recognized the existence of harmful exposures to silica which is borne out by the fact that wet methods were provided to 70.4 percent of the exposed workers.

Further study of this table reveals a lack of control against dermatitis producers (not otherwise specified) with 90.1 percent of the workers without protection. A high percentage of workers exposed to other materials capable of producing dermatitis have no control. For example, the percentage of workers with no control when exposed to ink was 100.0 percent, cyanide 45.5 percent, other coal tar products 63.8 percent and hides 100.0 percent. On the other hand, of the exposures to arsenic only 2.9 percent were without control which indicates the recognition of an important health hazard.

It should be emphasized that, since a control measure was recorded regardless of its adequacy, the data in these tables should not be interpreted as meaning that the available controls afford adequate protection. In the absence of scientific data as to the degree of exposure to a given material, or of the efficiency of the control, these control data can only be considered as recognition on the part of industry that a potential health hazard exists and that some attempt has been made to control that hazard.

TABLE 15—NUMBER OF WORKERS EXPOSED TO SPECIFIED MATERIALS AND NUMBER OF EXPOSED WORKERS PROVIDED WITH INDICATED CONTROL MEASURES (ALL SURVEYED INDUSTRIES)

Materials	Number of Exposures	Number of Exposed Workers Having Indicated Control										
		Gen. Ventilation										
		Positive	Negative	Local Exhaust	Enclosed Process	Wet Methods	Gas Masks	Respirators	Pressure Helmets	Protective Clothing	Other	No Control
Number of workers surveyed	27,541	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Number of exposures	79,688	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
All Specified Materials		23,397	19,922	2,218	1,237	18,250	4	1,110	25	978	12,677	20,778
Silica dust	7,670	2,799	2,959	113	43	5,396	.....	252	.....	.....	766	1,454
High humidity	7,550	2,713	3,380	25	28	.....	.....	.....	.....	.....	469	1,204
Other gases (N.O.S.)*	7,401	2,464	599	232	168	.....	.....	.....	4	.....	2,081	1,890
Silicate dust	7,376	2,799	2,969	129	52	5,330	.....	223	.....	.....	369	598
Extreme temperature changes	7,342	2,516	3,160	94	2	.....	.....	.....	.....	1	690	915
Other metals (N.O.S.)*	7,330	2,680	2,926	105	15	5,087	.....	55	1	.....	739	583
Carbon monoxide	7,035	2,491	582	222	50	.....	.....	.....	.....	.....	2,212	1,663
Petroleum products	3,849	8	211	37	57	.....	.....	6	4	258	312	3,215
Oils, fats and waxes	3,445	2,516	365	11	.....	.....	.....	1	.....	.....	263	384
Acids, mineral	3,290	149	66	71	18	38	.....	30	.....	664	585	2,048
Lead	3,194	662	946	155	34	949	2	140	1	10	898	494
Zinc	2,295	484	827	97	16	875	.....	106	.....	.....	661	120
Organic dust	1,608	19	45	443	36	7	.....	16	.....	.....	205	881
Oxides of nitrogen	1,455	71	57	2	3	.....	.....	.....	4	.....	593	734
Defective illumination	1,289	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,289
Other dermatitis producers (N.O.S.)*	878	.....	.....	22	44	.....	.....	.....	.....	.....	12	794
Coal dust, bituminous	831	606	.....	.....	.....	.....	.....	.....	.....	.....	6	219
Other organic solvents (N.O.S.)*	819	8	101	42	232	.....	2	1	4	.....	159	312
Sulfur dioxide	672	46	61	43	112	.....	.....	.....	.....	.....	311	139
Non-siliceous dust	648	24	.....	72	30	74	.....	54	3	.....	121	303
Arsenic	556	141	2	12	79	91	.....	84	1	21	419	16
Antimony	465	173	116	15	.....	2	.....	.....	.....	.....	249	102
Manganese	366	.....	.....	3	.....	46	.....	24	.....	.....	314	3
Paint and enamel	364	2	59	.....	3	.....	.....	62	1	2	53	220
Alkalies	352	.....	6	60	65	.....	.....	.....	.....	10	24	237
Other chemicals (N.O.S.)*	306	1	10	64	15	.....	.....	.....	.....	5	8	212
Alcohols, esters and ethers	226	4	52	.....	4	.....	.....	1	.....	.....	54	115
Phosphorous	145	8	50	30	13	48	.....	22	.....	.....	.....	44
Ink	124	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	124
Cyanide	112	.....	.....	25	8	3	.....	3	.....	.....	25	51
Other coal tar products (N.O.S.)*	105	3	13	10	5	.....	.....	.....	.....	6	3	67
Acids, organic	92	.....	.....	.....	10	.....	.....	.....	.....	.....	6	76
Lacquer and varnish	92	.....	35	.....	3	.....	.....	29	1	.....	5	38
Hides	59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	59
Halogenated hydrocarbons	48	2	18	15	27	.....	.....	.....	.....	.....	.....	12
Salt	47	.....	.....	.....	.....	.....	.....	.....	.....	1	1	45
Dyes	46	.....	.....	.....	10	.....	.....	.....	.....	.....	1	35
Hydrogen sulfide	41	.....	.....	26	.....	.....	.....	.....	.....	.....	11	4
Chlorine	38	.....	3	22	33	.....	.....	.....	.....	.....	.....	.....
Infections	34	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	34
Mercury	33	.....	.....	.....	1	.....	.....	.....	.....	.....	18	14
Cadmium	30	8	.....	21	21	.....	.....	1	1	.....	29	.....
Aldehydes	15	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	10
Sulfur	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
Benzol	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
Asbestos dust	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Chromium	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1

*Not Otherwise Specified.

TABLE 16—NUMBER OF WORKERS EXPOSED TO SPECIFIED MATERIALS, AND PERCENT OF EXPOSED WORKERS PROVIDED WITH INDICATED CONTROL MEASURES (ALL SURVEYED INDUSTRIES)

Materials	Number of Exposures	Percent of Exposed Workers Having Indicated Control										
		Gen. Ventilation		Local Exhaust	Enclosed Process	Wet Methods	Gas Masks	Respirators	Pressure Helmets	Protective Clothing	Other	No Control
		Positive	Negative									
All Specified Materials	79,688	29.4	25.0	2.8	1.6	22.9	0.0	1.4	0.0	1.2	15.9	26.1
Silica dust	7,670	36.5	38.6	1.5	0.6	70.4	.....	3.3	.....	.....	10.0	19.0
High humidity	7,550	35.9	44.8	0.3	0.4	.....	.....	.....	.....	.....	6.2	15.9
Other gases (N.O.S.)*	7,401	33.3	8.1	3.1	2.3	.....	.....	.....	0.1	.....	28.1	25.4
Silicate dust	7,376	37.9	40.3	1.7	0.7	72.3	.....	3.0	.....	.....	5.0	8.1
Extreme temperature changes	7,342	34.3	43.0	1.3	0.0	.....	.....	.....	.....	0.0	9.4	12.5
Other metals (N.O.S.)*	7,330	36.6	39.9	1.4	0.2	69.4	.....	0.8	0.0	.....	10.1	8.0
Carbon monoxide	7,035	35.4	8.3	3.2	0.7	.....	.....	.....	.....	.....	31.4	23.5
Petroleum products	3,849	0.2	5.5	1.0	1.5	.....	.....	0.2	0.1	6.7	10.0	83.4
Oils, fats and waxes	3,445	73.0	10.6	0.3	.....	.....	.....	0.0	.....	.....	7.6	11.1
Acids, mineral	3,290	4.5	2.0	2.2	0.5	1.2	.....	0.9	.....	20.2	17.8	62.2
Lead	3,194	20.7	29.6	4.9	1.1	29.7	0.0	4.4	0.0	0.3	28.1	15.5
Zinc	2,295	21.1	36.0	4.2	0.7	38.1	.....	4.6	.....	.....	28.8	5.2
Organic dust	1,608	1.2	2.8	27.5	2.2	0.4	.....	1.0	.....	.....	12.7	54.8
Oxides of nitrogen	1,455	4.9	3.9	0.1	0.2	.....	.....	.....	0.3	.....	40.8	50.4
Defective illumination	1,289	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0
Other dermatitis producers (N.O.S.)*	878	.....	.....	2.5	5.0	2.2	.....	.....	.....	.....	1.4	90.1
Coal dust, bituminous	836	72.9	.....	.....	.....	.....	.....	.....	.....	.....	0.7	26.4
Other organic solvents (N.O.S.)*	819	0.1	12.3	5.1	28.3	.....	0.2	0.1	0.5	.....	9.9	38.1
Sulfur dioxide	672	6.8	9.1	6.4	16.7	.....	.....	.....	.....	.....	46.3	20.7
Non-siliceous dust	648	3.7	.....	11.1	4.6	11.4	.....	8.3	0.5	.....	18.7	46.8
Arsenic	556	25.4	0.4	2.2	14.2	16.4	.....	15.1	0.2	3.8	75.4	2.9
Antimony	465	37.2	24.9	3.2	.....	0.4	.....	.....	.....	.....	53.5	21.9
Manganese	366	.....	.....	0.8	.....	12.6	.....	6.6	.....	.....	85.8	0.8
Paint and enamel	364	0.6	16.2	.....	0.8	.....	.....	17.0	0.3	0.6	15.0	60.4
Alkalies	352	.....	1.7	17.0	18.5	.....	.....	.....	.....	2.8	6.8	67.3
Other chemicals (N.O.S.)*	306	0.3	3.3	20.9	4.9	.....	.....	.....	.....	1.6	2.6	69.3
Alcohols, esters and ethers	226	1.8	23.0	.....	1.8	.....	.....	0.4	.....	.....	23.9	50.9
Phosphorous	145	5.5	34.5	20.7	9.0	33.1	.....	15.2	.....	.....	.....	30.3
Ink	124	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0
Cyanide	112	.....	.....	22.3	7.1	2.7	.....	2.7	.....	.....	22.3	45.5
Other coal tar products (N.O.S.)*	105	2.9	12.4	9.5	4.8	.....	.....	.....	.....	5.7	2.9	63.8
Acids, organic	92	.....	.....	.....	10.9	.....	.....	.....	.....	.....	6.5	82.6
Lacquer and varnish	92	.....	38.0	.....	3.3	.....	.....	31.5	1.1	.....	5.4	41.3
Hides	59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0
Halogenated hydrocarbons	48	4.2	37.5	31.3	56.3	.....	.....	.....	.....	.....	.....	25.0
Salt	47	.....	.....	.....	.....	.....	.....	.....	.....	2.1	2.1	95.7
Dyes	46	.....	.....	.....	21.7	.....	.....	.....	.....	.....	2.2	76.0
Hydrogen sulfide	41	.....	.....	63.4	.....	.....	.....	.....	.....	.....	26.8	9.8
Chlorine	38	.....	7.9	57.9	86.8	.....	.....	.....	.....	.....	.....	.....
Infections	34	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0
Mercury	33	.....	.....	.....	3.0	.....	.....	.....	.....	.....	54.5	42.4
Cadmium	30	26.7	.....	70.0	70.0	.....	.....	3.3	3.3	.....	96.7	.....
Aldehydes	15	.....	.....	.....	.....	.....	.....	.....	.....	.....	33.3	66.6
Sulfur	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0
Benzol	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0
Asbestos dust	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0
Chromium	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100.0

*Not Otherwise Specified.

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APPENDIX

form 3

MONTANA INDUSTRIAL HYGIENE SURVEY
INDUSTRIAL HEALTH SERVICES DATA

Surveyed by: .....

Name of Plant: ..... Industry Code: ..... Date: .....

Location: ..... County: ..... (M .....
(
Plant Official: ..... Title ..... No. of employees: (F .....
(
Products Mfg. or Service: ..... (T .....

SAFETY PROVISIONS

Safety Director	Full Time	
	Part Time	
Shop Committee		
Insurance Company Service		
Others		

BENEFITS AND RECORDS

Sick Benefit Organization	
Sickness Record	
Accident Record	
Seasonal	
Operating Period	
Remarks:	

MEDICAL PROVISIONS

Hospital	Company	
	Contract	
	Insurance	
First Aid Room		
First Aid Kit		
Trained First Aid Worker		
Physician	Full Time	
	Part Time	
	Insurance	
	On Call	
Nurse	Type	PH / RN / Oth
	Full Time	
	Part Time	
Physical Exam.	Pre-Employment	
	Periodical	
Remarks:		

SANITATION

WASTE DISPOSAL			WATER AND OTHER	
HUMAN			Municipal Supply	
Municipal			Private Supply	
Private			Spring	
Dry			Well	
Water Carriage			Stream	
INDUSTRIAL			Fountain	
Municipal			Individual Cup	
Private			Common Cup	
Dry		Fluid	Wash Room	
FINAL DISCHARGE			Shower	
Amount	Stream	Pit	Common Towel	
			Other Towel	
Other (Specify)			Sep. Lunch Rm.	
			Individ. Locker	
Remarks:			Remarks:	

form 4

MONTANA INDUSTRIAL HYGIENE SURVEY

WORK ROOM DATA

Page:..... of:.....

Name of Plant: ..... Location: ..... Code and No:.....

Department: ..... Work Room:.....

Informant's Name: ..... Surveyed by:..... Date:.....

Occupation	Number of Persons M	F	T	Nature of Job	Raw Materials and By Products	Exposure Code	CONTROL MEASURES: Gen'l. Vent. Pos. / Neg.	Loc. Exh.	Enc. Proc.	Wet Meth.	Gas Mask	Respirator	Pres. Helmet	Prot. Clo.	Other	Remarks:
Totals Fwd.																
Total																